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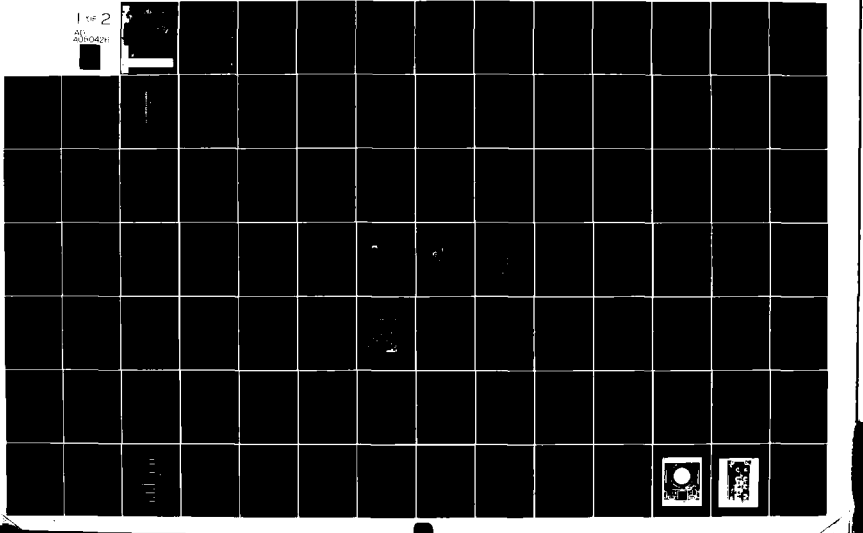

LEVEL II

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E-2 SYSTEMS APPROACH TO TRAINING: DEVELOPMENT, IMPLEMENTATION, EVALUATION AND REVISION

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This report describes the procedures employed in the application of Instructional Systems Development (ISD) in the E-2 aircrew training community. Phase I, which involved the analysis and design study, is summarized. Phase II, which involved development, implementation and evaluation, is described in detail along with an evaluation of the program's effectiveness. Additionally, a Follow-on Revision effort is documented. →(Continued on reverse side)

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The model which provided the direction for this effort was developed by the contractor in consonance with the Systems Approach to Training (SAT). The Statement-of-Work provided by the Naval Training Equipment Center followed the traditional approach to ISD. The Phase II and Follow-on Revision efforts were conducted jointly by the Navy's E-2 training squadrons (RVAW-120 and RVAW-110) and the contractor.

Outputs of the ISD effort to date include fully implemented and revised E-2C syllabi for pilot and NFO/FT training and E-2B pilot training. Additionally mediated lessons covering ISD procedures were developed by the contractor for generic as well as E-2 utility.

Results of the evaluation indicate that ISD has produced an E-2 aircrew training program which is both valid and cost-effective. Substantial reductions in course length have been achieved, while training effectiveness appears to have been significantly improved.

SUMMARY

This report describes the procedures employed in the application of instructional Systems Development (ISD) in the E-2 aircrew training community. Phase I, which involved the analysis and design study, is summarized. Phase II, which involved development, implementation and evaluation, is described in detail along with an evaluation of the program's effectiveness. Additionally, a Follow-on Revision effort is documented.

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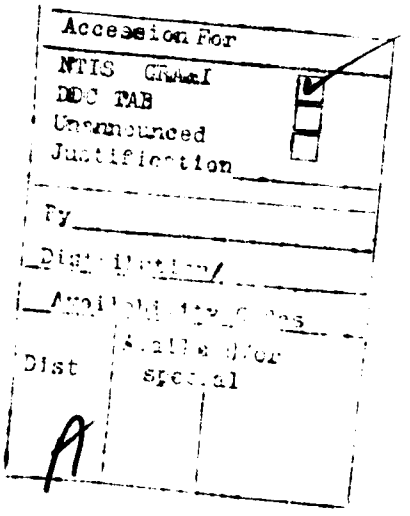

PREFACE

The work discussed in this report represents the culmination of the formal development, implementation, evaluation and revision of the E-2 Aircrew Training Program. This effort was one of four such projects (A-6E, EA-6B, E-2B/E-2C and SH-2F Weapons Systems) begun in early 1975 by the Naval Training Equipment Center for the Naval Air Systems Command, to develop aircrew training systems and to establish the requirements for implementing the systems approach to training within the Naval aviation community. This program was the second of the four to go on-line and fleet feedback indicates a marked improvement in the overall quality of the program graduates.

Appreciation is expressed to those personnel of RVAW-120, RVAW-110, COMNAVAIRLANT, COMNAVAIRPAC, and COMCAEWWING TWELVE who made significant contributions to this project.

Robert G. Bird
ROBERT G. BIRD

Walter H. Maddox
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Acquisition Directors

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INTRODUCTION

PROGRAM GOALS AND CONSTRAINTS

The Naval Training Equipment Center (NTEC) is currently involved in a comprehensive program of Instructional Systems Development (ISD) within the aviation training community. The overall program began in March of 1974 when NTEC awarded a contract for the design and development of an aircrew training program for the SH-2F LAMPS aircraft. This was followed in April with similar contracts for the A-6E TRAM, EA-6B ICAP and E-2C weapon systems. The contracts called for a two-phased effort. Phase I involved the development of Task Analyses, Behavioral Objectives, Training Support Requirements (media), and Lesson Specifications. Phase II involved Instructional Materials Development, Instructor Training, Implementation, Evaluation, and Revision. The E-2 ISD program is one of two such programs which have completed the Phase II effort to date. While both programs have been developed within the guidelines of the ISD framework, each has used divergent methodologies to achieve the end-products and each has been adapted to the unique requirements of differing aircrew training systems, missions, and squadrons. The purpose of this Training Program Work Report is to document the procedures employed in Phase II of the E-2 ISD effort, to examine their effectiveness, and to evaluate the outcome of the overall training program.

NTEC's project outline (N215-263) for the Phase II effort specified the following objectives:

a. To produce an initial version of aircrew training materials for E-2C aircrews;

b. To supplement the instructional materials with appropriate media;

c. To implement the complete program at RVAW-120, NAS Norfolk;

d. To evaluate the effectiveness of the program and generate specifications for needed revisions;

e. To revise the programs according to the specifications;

f. To develop an in-depth instructor training program;

g. To tabulate manpower and cost data for future planning purposes; and

h. To document the Phase II effort.

The outline further delineated that the project would include the following tasks:

(1) Instructional Materials Development;

(2) Evaluation Planning;

(3) Implementation Planning;

(4) Instructor Training Course Development;

(5) Implementation and Evaluation;

(6) Revision; and

(7) Resource Utilization Data.

Prior to award of the contract, the scope of the program was expanded to include the adaptation of the E-2C effort to E-2B pilot/copilot training as well. Additionally, the task of incorporating all E-2C ISD documentation into a computer data base for the Aviation Training Support System (ATSS) was specified.

Preparation for Phase II of the E-2 ISD effort began in April of 1976 with the project specification (N215-263) which was followed by delivery of the contractor's proposal in June. Proposal Review Meetings were then held at NAVAIR on 21 July and at RVAW-120 on 28 July. One outcome of these meetings was the Navy's approval of the contractor's Task Analyses, Behavioral Objectives and Lesson Specifications from the Phase I effort. A second outcome was a decision to heavily integrate Naval personnel into the Phase II development process, using RVAW-120 E-2C Subject Matter Experts (SME's) as authors of the rough draft instructional materials under the guidance of the contractor's instructional psychologists (IP's). Accordingly, it was determined that the squadron would establish a Training Development Department (TDD) composed of E-2C pilots and NFO's, and that the contractor would establish a field office co-located with the squadron and staffed with IP's and support personnel. Portions of the effort, including graphic-arts services, were allocated to the contractor's main offices, however. To accomodate the development of a corresponding ISD-based training program for E-2B pilot/copilot training, it was further determined that RVAW-110, NAS Miramar, would direct the efforts of its ISD department to the authoring of E-2B instructional materials through conversions of the Phase I E-2C analyses and the Phase II E-2C draft lessons under the direction of the contractor. The contract was subsequently awarded on 5 October 1976. Kick-off meetings were held at RVAW-120 on 26 October and RVAW-110 on 3 November. At this time, the contractor's work plan was presented and the various responsibilities were delineated. The proposed Work Schedule is shown in Figure 1. The tasks of Instructional Materials Development and ATSS Data Encoding were assigned to the Navy, with the contractor in a supervisory/support role. The tasks of Evaluation Planning, Implementation Planning, and Instructor Training Course Development were assigned to the contractor with the Navy in a consulting role.

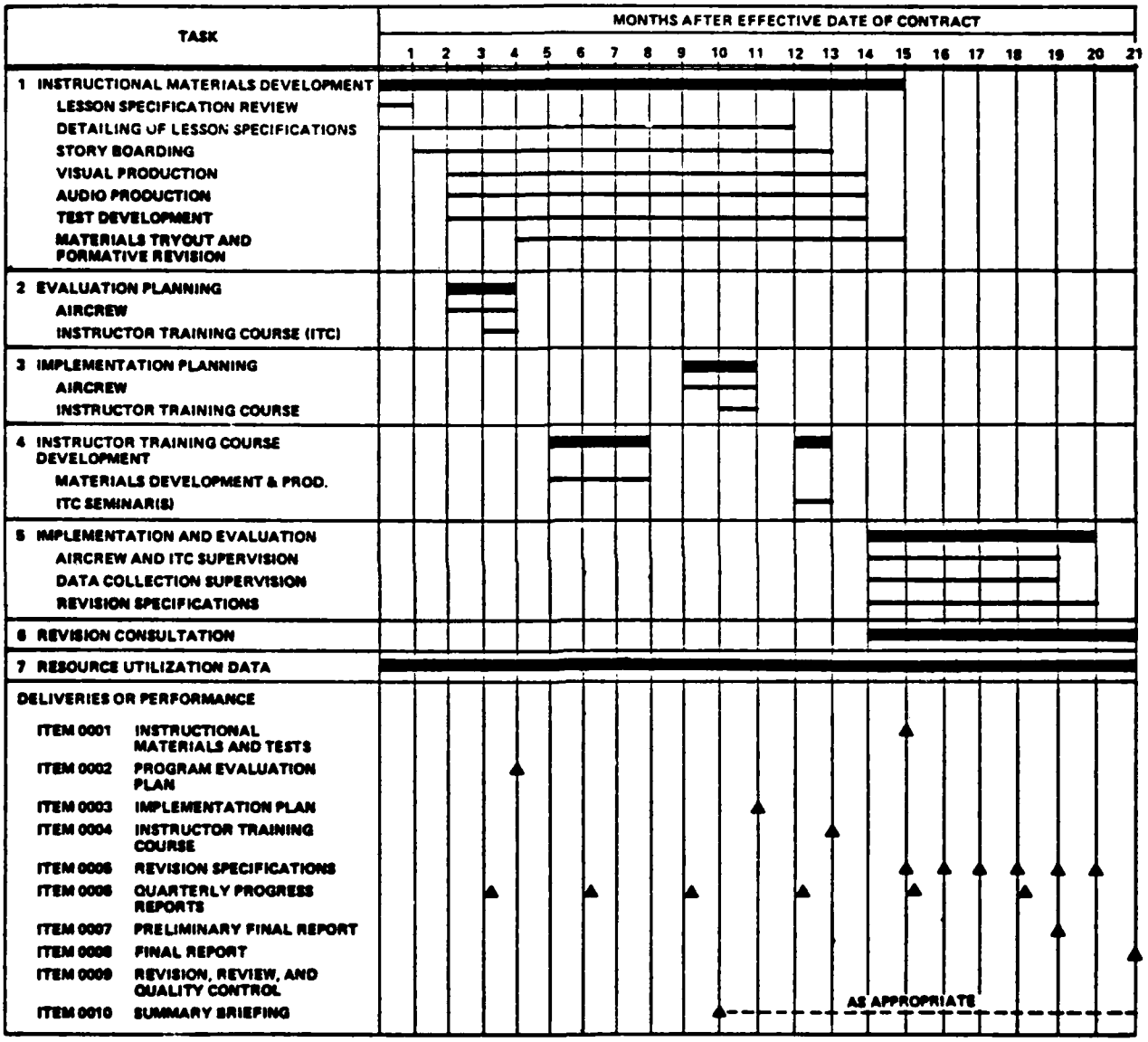


Figure 1. Phase II Proposed Work Schedule

The program commenced on schedule. At the half-way point in the Instructional Materials Development schedule, however, two modifications to the basic contract became necessary. The first involved the transfer of the ATSS Data Encoding task to the contractor, and the second involved the hiring of two contractor SME's to supplement the Navy's manpower commitment to the Instructional Materials Development task. The addition of these resources greatly facilitated the completion of the developmental tasks and the implementation of the program within the originally specified contract period.

A second contract was awarded prior to the completion of the Phase II tasks to provide contractor support for a follow-on revision period. Figure 2 delineates the tasks involved in that effort and depicts the proposed Work Schedule. The primary tasks were an extension of the summative evaluation, the development of further revision specifications, and the production of revised training materials. This effort was based on a projected requirement to revise approximately 20% of the total instructional materials and to "fine-tune" the system as a result of input from the summative evaluation. The 20% revision requirement was later increased to accomodate a major change in the NFO mission software, and the contract was amended accordingly.

Secondary tasks in the follow-on contract involved the development of a comprehensive individualized Instructor-Under-Training (IUT) Syllabus. Of particular importance to that effort was the inclusion of a series of slide/tape presentations for generic use in training the ISD prescribed procedures for development, implementation, and quality control.

PROBLEM/BACKGROUND

The E-2 project has been an effort to apply the principles of ISD to operator training in an existing system. The training requirement involves five aircrew positions; the pilot, copilot, combat information center officer (CICO), air control officer (ACO), and the flight technician (FT). This carrier-based aircrew must be trained to perform the primary mission of Airborne Early Warning (AEW) and the secondary missions of Surface-Subsurface-Surveillance Control (SSSC), Anti-Submarine Warfare (ASW) Support, Search and Rescue (SAR), Lost Plane/Emergency Tanking, E-2 Controlled Approach, Anti-PT Boat Tactics, and Command and Control. Training for the E-2C is conducted at RVAW-120 NAS, Norfolk. Training for the E-2B is conducted at RVAW-110 NAS, Miramar. During the Phase I analysis and in the development period of the Phase II effort, training at RVAW-120 utilized classroom presentations for academic training, the 15F8 Tactics Trainer and the E-2C aircraft for NFO/FT performance training, and the Cockpit Procedures Trainer (CPT) and the E-2C aircraft for pilot/copilot performance training. At this time, an Operational Flight Trainer (OFT) was under procurement. Training for E-2B pilots at RVAW-110 utilized a similar program with a more sophisticated E-2B CPT and the E-2B aircraft. Procurement of an E-2C CPT and an E-2C OFT was also in progress for E-2B/E-2C training at RVAW-110.

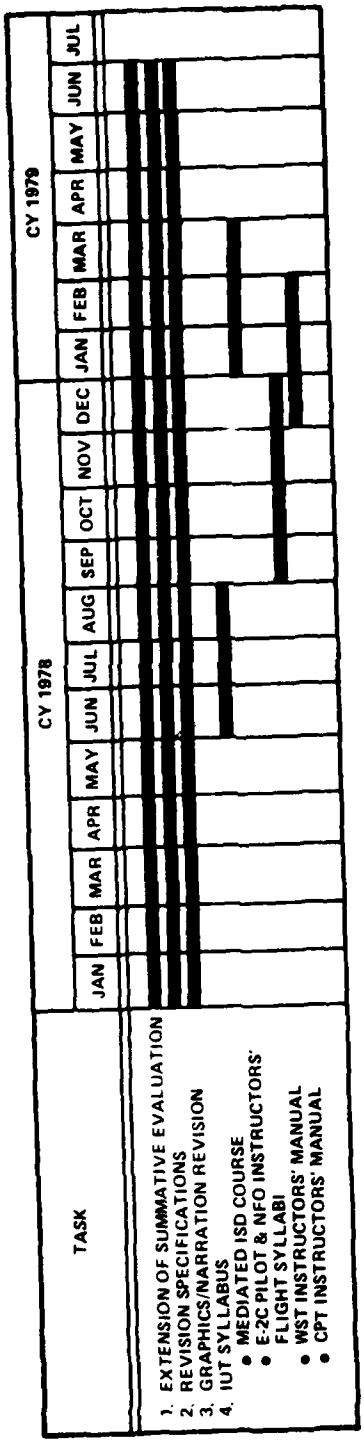


Figure 2. Follow-on Revision Work Schedule

Upon completion of the Phase I ISD analyses, the contractor determined that the existing E-2 Training programs could be enhanced in both learning effectiveness and cost-effectiveness through conversion to an individualized instructional system developed within the context of a Systems Approach to Training. The proposed instructional system provided for a series of modules, most often beginning with cognitive lessons to present academic prerequisites and ending with performance applications in practice or sortie/scenario lessons. Thus a building-block approach was designed within and among modules leading to the final course criterion of NATOPS qualification. Each Lesson Specification was based on Behavioral Objectives derived from a Task Analysis. Provisions were made for criterion testing of all Training Objectives covered in each lesson. Tape/slide presentations were selected for the primary cognitive instructional media, with self-scoring answer sheets serving the testing function. Existing simulators and those under procurement were then integrated into the syllabus along with the cognitive lessons and E-2 aircraft flights in a manner directly traceable to the Behavioral Objectives. Finally, the addition of a tape/slide presentation capability in the CPT was recommended to increase its utility in pilot/copilot training within the ISD-based system.

The individualized instructional system which was specified for the E-2 aircrew was designed to:

(1) promote learning efficiencies through self-pacing, immediate feedback, early hands-on training, and criterion referencing;

(2) increase instructor effectiveness through direct student contact (one-to-one) as needed; and

(3) enhance training system operations through flexible scheduling.

SECTION II

INSTRUCTIONAL SYSTEMS DEVELOPMENT

BACKGROUND

Much of the Instructional System Development (ISD) methodology has been in existence for many years. However, it is only within the last few years that the methodology has been formalized into a usable, documented technology. According to a definition given in Air Force Manual 50-2, Instructional System Development (1970), ISD is a:

> "deliberate and orderly process for planning and developing instructional programs which insures that personnel are taught the knowledges, skills, and attitudes essential for successful job performance."

This is obviously not a new goal in aircrew training or educational technology, as a whole. The new aspect that ISD brings to training is the use of systems analysis techniques in an attempt to relate the training objectives to realistic job performance requirements. That is, teach the individual all of the information which is necessary.

Through the conduct of the present E-2 program and a previous program on a very different multicrew aircraft system (Air Force B-1 strategic bomber), the contractor examined, evaluated, and expanded the Systems Approach to Training, SAT methodology. The total "system" of information involved in the SAT methodology, as defined by the contractor, is illustrated in Figure 3. This systematic approach to information accumulation and application ensures that the analysis is comprehensive and logical. The conceptualized flow of information highlights numerous interactions among facts, assertions, assumptions, and constraints. Some attempt was made to order (vertically) the blocks in a chronological manner according to approximately when they take predominance in consideration. The blocks with the same number share some common attribute. A brief description follows.

The focus of the SAT methodology is centered around making the training responsive to the mission requirements of the man-machine system. The man-machine system can be partitioned into two components, functions performed by the human operator (1a) and functions performed by the machine (1b). These functions and the interface between the man and the machine are inputs to the training analysis. In addition, there are often operational policies (1c) that impact upon the training system which must be addressed. Although these policies are input to the system initially, it is possible that the training analysis reveals information that subsequently leads to policy changes. Another set of inputs to the training analysis involves the economic information (1d) pertaining to such things as the costs of instructional material, training devices, facilities, and personnel.

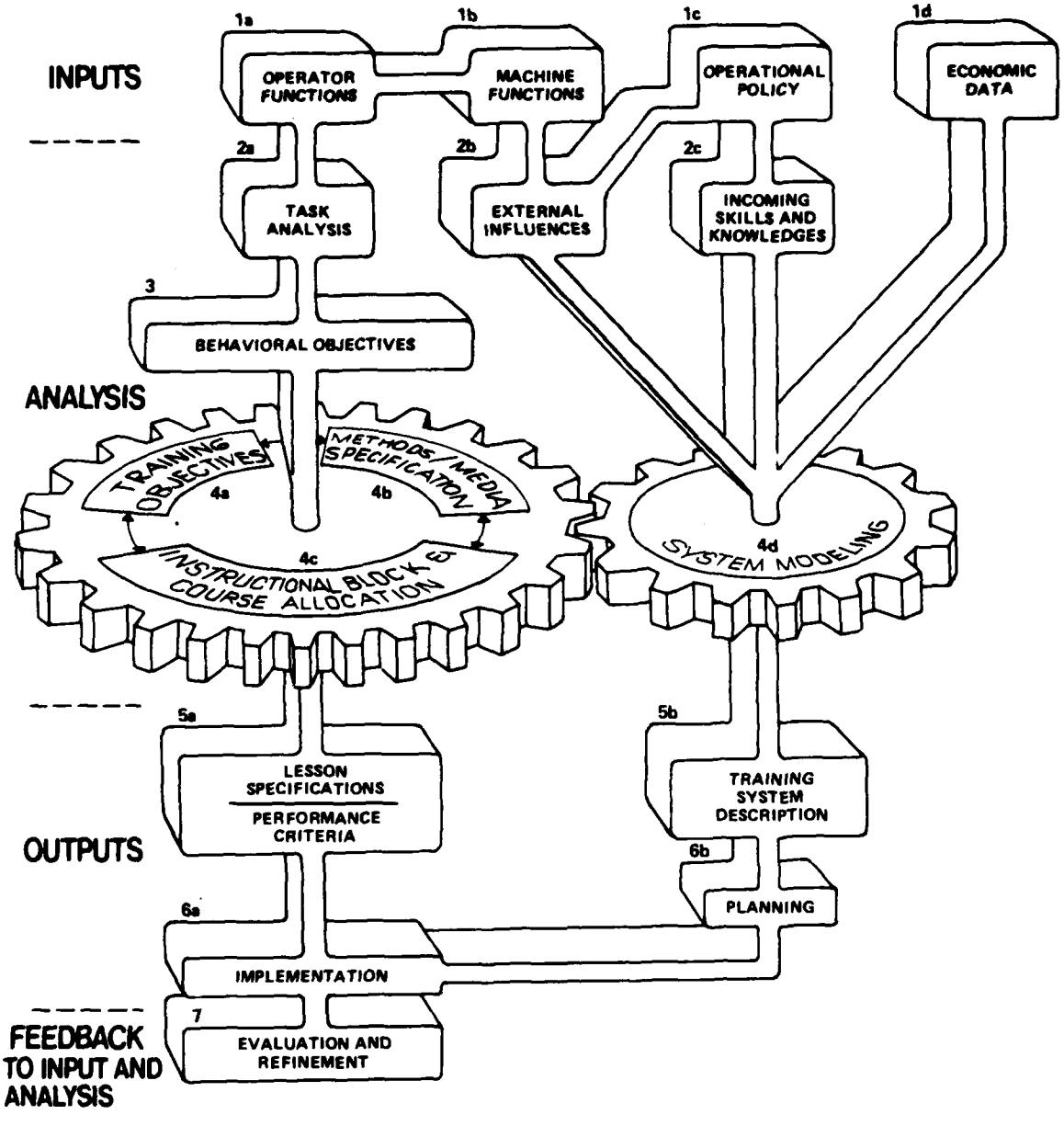


Figure 3. System Components for the Development of Training

The first phase of the analyses includes determining and documenting the human operator functions in terms of a task analysis (2a). The machine functions are also analyzed to establish the external influences (or constraints) (2b) that are imposed on the training program (e.g., airborne safety considerations). Another contributor to the external influences includes the policies of both the training and the operational communities. The trainees' incoming skills and knowledges (2c) are a function of the operational policy in terms of the determination of the sources of trainees. The external influences and incoming skills and knowledges can be considered as "boundary conditions" for the training analysis. Those behaviors which must be demonstrated by the trainees before graduation are logically grouped into behavioral objectives (3) along with synopses of training-relevant data pertaining to each objective.

The greatest point of departure of this SAT "model" from traditional flow charts is the iterative process indicated by the "cogwheel" supporting blocks 4a, b, and c. The training objectives (4a) may, in a simplified way, be thought of as those behavioral objectives not already in the incoming repertoire of behavior (but couched in training terms rather than operational mission terms). Methods (instructional strategies) and media (training devices) are specified (4b) which can supply the appropriate training environment. Instructional sequencing of objectives into courses (4c) provides a syllabus. Each of these blocks (4a, b, c) are interdependent in that multi-dimensional criteria are applied. For example, the selection of a training device is dependent on economic factors, including device utilization. Device utilization, on the other hand, interacts with the training objectives via the level determined for incoming skills and knowledges. But still, the training objectives themselves are formulated with some knowledge of the devices that may be available for instructing and testing. To aid in this process of developing the syllabus, a model of the instructional system (4d) may be invaluable, depending on the degrees of freedom allowed to the training analysts. The model takes as inputs the hypothesized syllabus (4c), the external influences (2b), the incoming skills and knowledges (2c), and the economic data (1d), to determine the ramifications on the training system (5b) via critical descriptors. The detailed description of the syllabus itself is contained in the lesson specifications and performance measures (5a). Implementation (6a) of the latter provides evaluation data (7) for quality control feedback, while the training system descriptors provide planning data (6b) for major alterations in the structure of the overall instructional system.

The SAT methodology, as discussed here, is not an algorithm that "spits out" answers; but rather, it is a conceptual framework that serves as a decision aid to be used in documenting and presenting the information to decision makers. The relative emphasis on the various components of the SAT process is different depending upon whether one is developing a future training program, modifying an existing program, or investigating a particular component of the system.

ASSUMPTIONS (GENERIC)

The following assumptions apply to the contractor's approach to ISD for operator training in an existing system:

- Principles of learning and a technology of instruction are now available which can be successfully applied in the operational training setting.
- The application of ISD to an existing training system will result in significant increases in both learning effectiveness and cost effectiveness, while providing greater responsiveness to the needs of the operational environment.
- The most effective approach to ISD is not a fully proceduralized one, but rather a systematic one following the traditional steps, while recognizing the iterative nature of the processes involved and relying on expert judgments.

ASSUMPTIONS (E-2 SPECIFIC)

The entire Instructional System Development (ISD) process previously described consists of decision processes based on data. The data are composed of descriptive facts, research results, assertions (the result of prior decisions), assumptions, and constraints. This section will enumerate those items which fall into the category of assumptions. Although these "external influences" are subject to change (and in fact, have changed), the following are those that either were agreed upon by NAVTRAEQUIPCEN'S contract monitor to be a reasonable basis for accomplishing the work under the contract or which were implied or stated in the statement of work.

- The proposed training program will be for all crew stations of the E-2C aircraft and will be implemented by personnel of the RVAW-120 Squadron, Norfolk Naval Air Station. (This assumption applied to Phase I only. The scope of the effort was expanded to include the E-2B pilot/copilot training task prior to award of the Phase II contract.)
- The trainee flow will remain constant at approximately 30 NFO/FT and 36 pilots per year and will derive from the same sources including both "nuggets," Undergraduate Pilot Training/Undergraduate Navigators Training (UPT/UNT) graduates, and transitioning crews. In particular, it was assumed that the West Coast E-2C pilots will not be processed through RVAW-120. (This assumption was modified after the start of Phase II. A separate track of the pilot syllabus, using portions of the primary ISD-based syllabus, was developed to accommodate this change.)
- The Airborne Intercept Control (AIC) course will remain at Dam Neck, i.e., it will not become part of the RVAW-120 curriculum. (This assumption was modified after the start of Phase II. An existing non-ISD curriculum was incorporated into the overall ISD-based system to accommodate this change.)

- No major equipment (simulators, trainers) will be procured to support the proposed training program, but the Operational Flight Trainer (OFT) will be ready for training at the time of implementation. (This assumption was also modified. An interim syllabus was developed during the final months of the Phase II Instructional Materials Development effort to accomodate this change.)

- Time available on existing training equipment will not be less than currently available; simulator time will be proportioned equally between use by trainees, operational crew members, and scheduled maintenance.

- No major hardware or software changes will impact on E-2 training during Phase II of the ISD efforts. (This assumption was modified. A separate track within the NFO/FT syllabus was developed to accomodate a major software change for the radar processing system. The incorporation of the "C-3" software required a major syllabus revision approximately one year after implementation).

- Navy SME's can be effectively utilized in the authoring of instructional materials (under the direction of the contractor's IP's) as well as in the tasks of Implementation, Evaluation, and Revision.

- Sufficient SME time will be provided on a non-interference basis by RVAW-120 and RVAW-110 to accommodate the Phase II production schedule. (This assumption changed requiring a contract modification to provide two contractor SME's as a supplement to squadron ISD resource personnel. Additionally, support was provided from the Wing on a temporary duty basis.)

- An Educational Specialist will be provided to assist in the ATSS Data Encoding task. (The loss of this billet necessitated a contract change to provide further contractor personnel support.)

- Existing slides for E-2 training support can be successfully and cost-effectively integrated into audio-visual lessons developed within the ISD framework.

- Adaptation of the E-2C ISD program to the additional requirement of E-2B pilot training can be accommodated with a level of effort and a resource expenditure of approximately 50% of that required for an original development effort.

METHODOLOGY (PHASE I) NAVTRAEQUIPCEN 78-C-0045-1

The contractor responded to the problem of developing an E-2 SAT program by coordinating the skills and experiences of specialists in the disciplines of psychology, education, human factors engineering, and aviation. Each of these specialists was selected for the effort on the basis of prior operational and/or training experience with military aircraft. In addition, one contractor analyst (a pilot/navigator - rated engineer) received additional subject matter expertise through participation in an E-2C NFO transition course at RVAW-120. These contractor personnel then performed the analysis and design effort in accordance with the contractor's "System Components for the Development of Training" model and associated procedures developed in a SAT effort for the B-1 aircrew. The Phase I effort was subsequently documented in NAVTRAEQUIPCEN Report No. 75-C-0101-1. A brief description of the approach and subsequent design recommendations is given in the paragraphs below.

The development of a comprehensive data base was the first task in applying the contractor's SAT model to the E-2C training program. This was accomplished through a two-faceted analysis. One facet involved an extensive analysis of the existing training program. The second facet consisted of a task analysis. The background information for the NFO task analysis was established through firsthand observation and recording of classroom presentations conducted by the RVAW-120 squadron training personnel. While this appeared to be the most efficient in terms of obtaining information about the NFO/FT training, the contractor's previous experience with the pilot/co-pilot training task and the availability of documentation (including recently developed audio-visual presentations) for a significant portion of that training, alleviated the necessity for a corresponding approach. In both cases, however, all available training documentation was collected for analysis. The following are representative:

a. Instructor Guides (in-house)

b. Student Handouts

c. Class Lecture Notes

d. CARAEWTRARON 120 INSTRUCTION 1500.1A

e. NATOPS (NAVAIR 01-E-2AAA-1)

f. OPERATIONAL DIAGNOSTIC FLIGHT MANUAL (NAVAIR 01-E2AAA-1A.2)

g. OPERATIONAL SOFTWARE FLIGHT MANUAL (NAVAIR 01-E2AAA-1A.1)

h. CREW OPERATORS CHECKLISTS (NAVAIR 01-E2AAA-1C)

i. CHECKLIST-POCKET (NAVAIR 01-E2AAA-1B)

j. GRUMMAN Instructor Program Guides

k. Operator Manuals for Training Devices

l. EDUCATIONAL SELF-AUDIT (RVAW-120, CNETS)

m. NAVAL FLIGHT OFFICER FUNCTION ANALYSIS: E-2B CICO (NAMRL)

These informational sources were then supplemented by informal interviews with the RVAW-120 training personnel and direct observations of operational equipment/simulators and crews. In this procedure, heavy reliance was made on two sources: subject matter expertise and operational documentation. These sources, together with classroom lecture notes covering operational information not otherwise available, provided the contractor with the basic information for preparing the task analysis listing.

The format which was employed for the task analysis was one adopted from experience with a previous training program design. The resulting data base consisted of a detailed hierarchical breakdown of all activities required to perform the mission. Of special significance was the level of detail (task element level), the mission-performance/system-operation orientation, and the display-operator-control relationships. Furthermore, an additional effort was made to include remarks pertinent to task performance but not directly reflected in the action statement. Much attention was given to this effort, as it was designed to provide the information necessary to formulate behavioral objectives and to provide the structure of the lesson specifications later in the program. The task analysis was sent to RVAW-120 and to NAVTRAEQUIPCEN for review. Input from RVAW-120 squadron training personnel was used in revisions of the task analytic information as it was incorporated into the lesson specifications.

The next step involved the identification of training objectives. This was basically a two-stage process. First, the task analysis was partitioned into a listing of discrete behavioral components that formulate the behavioral objectives. Included in the objectives are key features such as ratings of performance limits. As will be seen later in the discussion of lesson specification development, the behavioral objectives play a key role in establishing performance assessment criteria. The behavioral objectives, the second deliverable, were sent to NAVTRAEQUIPCEN and RVAW-120 for verification. The second stage involved the "subtraction" of the incoming skills and knowledges. These incoming skills and knowledges for various trainees were established through discussions with RVAW-120 personnel as well as an analysis of documents related to their previous training. Thus, the behavioral objectives minus the incoming skills and knowledges resulted in the listing of actual training objectives. These, too, were later used in the preparation of lesson specifications as the key determinants of content areas.

Integral to the preparation of lesson specifications were the media analysis and the determination of instructional strategies and sequences. The specification of training devices was based on the training objectives identified during the SAT process and was oriented toward obtaining the best possible trainee performance at the least possible cost. The sequencing of instructional blocks was based on both learning principles and effective resource (device) utilization.

The third and final task, resulting in a deliverable, was the preparation of lesson specifications. As alluded to earlier, each of the previous steps contributed directly to the product of this effort. The behavioral objectives, operational policy, availability of resources, and incoming skills and knowledges played a key role in the instructional design. Upon this information, the decision was made to develop an individualized instructional system using audio-visual presentations. Analysis of existing training devices/simulators and an additional operational flight trainer under procurement indicated that no costly hardware purchases would be necessary. It did appear, however, that training effectiveness could be enhanced by a more optimum use of these devices. The procurement of audio-visual carrels and a modification of the Cockpit Porcedures Trainer (addition of audio-visual capability) were the only new hardware requirements indicated.

The instructional strategy was developed in consideration of the student flow, the incoming skills and knowledges, available training resources, training objectives, and the concept of early hands-on training. The format of the lesson specification was thus designed to reflect an individualized approach, with instruction divided into three continuous domains - the cognitive, practice, and sortie/scenario. In the cognitive domain, the sequence of instruction was designed to present in a hierarchical manner (building a network of associations upon the developing repertoire) that information which directly contributes to mission performance and/or system operation. Accordingly, the structure of the training objectives was used as the basis for the teaching points in the lesson specifications. The ordering of the objectives was permuted, however, in consonance with learning strategies.

To facilitate the media lessonware preparation, the cognitive instruction was divided into teaching points with corresponding descriptions of media support. An effort was made to segment the teaching points into the smallest units of information appropriate for evaluation. In many cases, however, a number of tape/slide combinations were envisioned for the support of a single teaching point.

Cover sheets were developed which identify the lesson name and number, training objectives covered, evaluation criteria, prerequisite lessons, training devices required, projected training time, and any additional references. The cover sheets for cognitive lessons were followed by the sequence of instruction. Likewise, cover sheets for practice and sortie/scenario lessons were followed by behavioral objectives containing step-by-step procedures, conditions, and standards.

METHODOLOGY (PHASE II)

Based on the analyses and subsequent design recommendations which emerged from the Phase I E-2C ISD effort, the contractor undertook the tasks of Instructional Materials Development, ATSS Data Base Development, Evaluation Planning, Implementation Planning, Instructor Training Course Development, Implementation/Evaluation, and Revision Consultation in Phase II. The model which provided the direction for Phase I continued

to be used throughout Phase II, thus ensuring a comprehensive, iterative approach. However, a major difference in the employment of this approach was incorporated into the Phase II methodology. This difference involved a greater reliance on Navy SME's, using them for the authoring of rough draft instructional materials rather than as consultants on an input-output basis. While details of the implementation are presented in Section III of this report, the basic methodology is discussed in a step-by-step manner in the following paragraphs.

The first task within the Phase II methodology, Instructional Materials Development, was also the most complex, pervasive, and resource-consuming task. Primary inputs were the instructional system design, the training objectives, the syllabus flow charts, and the lesson specifications. This task, which spanned a period of twenty months, was comprised of the following sub-tasks: lesson specification review; detailing of lesson specifications; authoring and test development; production; and materials tryout and formative revision. The overall effort was managed by the contractor's principal investigator, the TDO (and training model manager) from RVAW-120, and the ISD officer from RVAW-110. SME's were integrated into the effort through the contractor's author-training materials and on-the-job training (OJT).

Lesson Specification Review preceded all other sub-tasks and involved a general course review as well as a pre-authoring activity of the SMEs. The course review process was conducted primarily by management personnel (IPs and senior SMEs) utilizing the syllabus flow charts. At this level, SME input resulted in some restructuring of the syllabus, with additions, permutations, and combinations of proposed lesson materials when required. All proposed revisions were carefully documented and linked to the task analysis and behavioral objectives documentation. The most significant revisions emerged from a need for more emphasis on the tactical areas, changes in the hardware/software, and squadron constraints regulating trainer and flight time. This effort was most heavily concentrated in the first months of the contract, but continued at a lower level throughout the entire instructional materials development task. The pre-authoring activity of the SMEs within this sub-task was at the more specific intra-lesson level, taking inputs from the lesson specifications developed by the contractor in Phase I. The effort was primarily directed toward revisions of the learning objectives which identified the proposed scope of the lessons, but extended to the level of supporting teaching points when required. The performance period extended throughout the authoring sub-task and in conjunction with that process.

Detailing of Lesson Specifications was a sub-task which was primarily the function of Navy and contractor SMEs. Here, the general outlines of the lesson specifications were expanded with the technical information necessary to provide specific teaching points. The output of this sub-task was a set of detailed lesson specifications to serve as guides for storyboarding tape/slide lessons and authoring classroom, practice, and sortie/scenario lessons. This documentation further served as input to the ATSS data base and as student handouts to augment the mediated lessons.

Authoring and Test Development, the most time-consuming sub-task, followed the detailing of lesson specifications and was primarily carried out by Navy and contractor SMEs, with editing by contractor technical writers and IPs. Three basic formats were employed. For classroom presentations, an existing Navy lecture guide format was adapted. The SMEs then transformed the detailed lesson specifications into this format, developed corresponding test items (based on the training objectives), and specified supporting overhead transparencies when required. For practice and sortie/scenario lessons, a new format was developed which presented proceduralized instructions for the students and the instructors and incorporated criterion-referenced testing. For tape/slide presentations, a detailed process of "storyboarding" was employed. The format provided for a frame by frame description of the visual, a corresponding narrative, and related test items. The output of the storyboarding effort consisted of several thousand pages of working documentation for input to the audio and visual production processes. A flow-chart depicting the corresponding review process is presented in Figure 4. The most significant problems at the "storyboard" level arose from deficiencies in the source documentation (e.g. NATOPS), lack of detail in production notes, and a tendency of the SMEs to put too much into one frame of instruction or to assume too much prerequisite learning. The extensive review process focused on reducing these discrepancies and ambiguities. Production then followed as a contractor subtask, with typing, printing, and duplication support for "hard copy" materials, and the complex audio-visual processes described in Appendix A for tape/slide lesson materials.

The second task, and one which proceeded concurrently with Instructional Materials Development, was the ATSS Data Base Development. Inputs for this task were the source documentation and all the analytical documentation from the Phase I design, and the actual instructional materials from Phase II. The task required a joint effort between the contractor and the Naval Weapons Center, China Lake. A conceptualization of the Instructional Systems Development Impact System Directory (ISDISD) was first formulated, followed by the specification of detailed data formats. The purpose of the ISDISD was to provide linkages between all data bases of ISD documentation to facilitate future revisions to the curriculum. The contractor's effort was to encode the data, while the Naval Weapons Center's effort was to keypunch the data and to develop the corresponding computer programs in accordance with NTEC's specification (MIL-T-29053). The outputs of this task were the following data bases for the E-2C documentation, with corresponding linkages: the Task Analysis Data Base, the Behavioral Objectives Data Base, the Hardware Data Base, the Software Data Base, and the Lesson Data Base.

The third task, Evaluation Planning, was conducted by the contractor's IP's, with input and review by RVAW-120 and RVAW-110 SME's and management personnel. Inputs for this task were the instructional system design, the Training Objectives, the course syllabus, and squadron resources and constraints. This two-month effort was conducted early in the program, providing for evaluation of both the aircrew training system and the Instructor Training Course (ITC). The contractor's IP's first developed a comprehensive model unique to the requirements of the E-2 ISD-based training system, and then specified procedures and formats for data collection. The resulting Evaluation Plan addressed both formative and summative evaluation requirements and procedures. Provisions were made to collect data for both

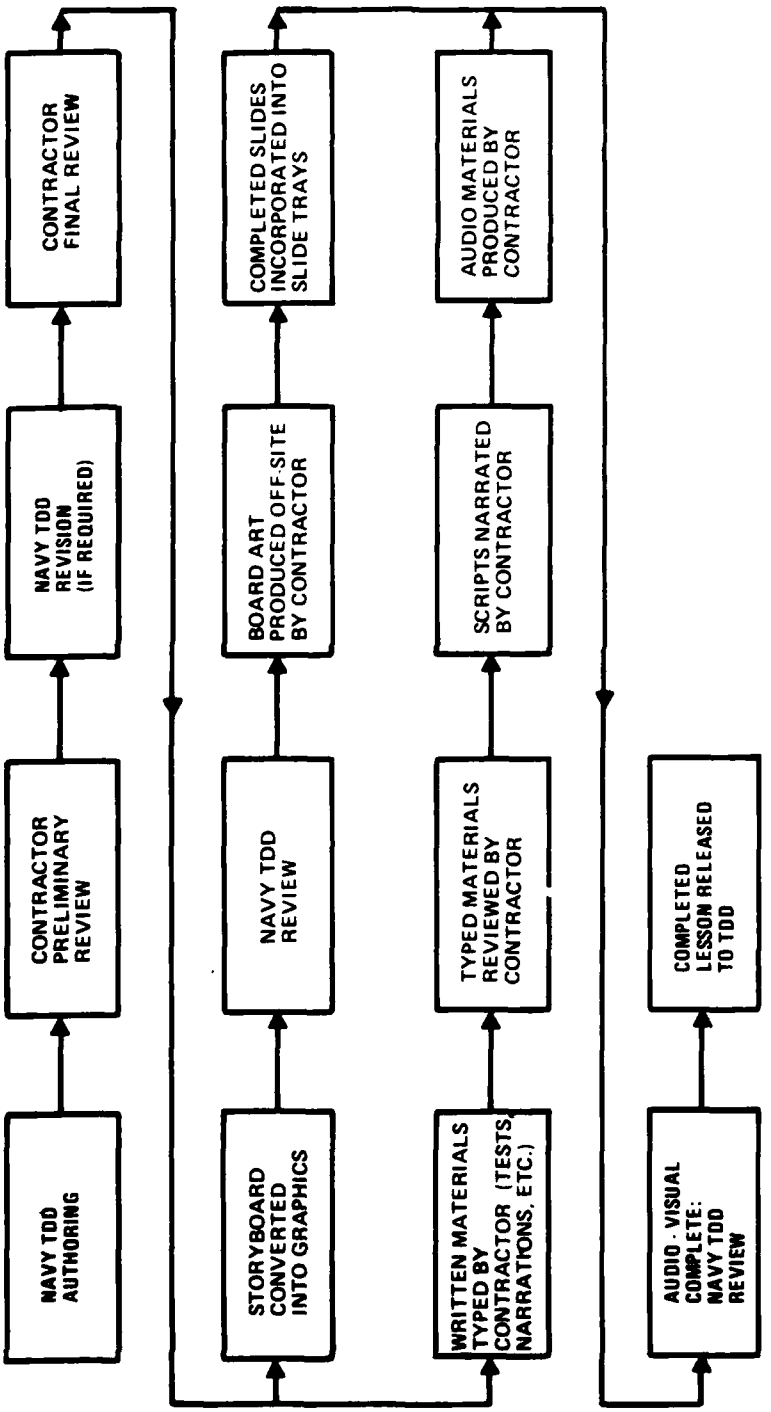


Figure 4. Lesson Development and Review Process

internal and external validation. Additionally, a conceptualization for incorporating evaluation data into the ATSS was formulated. The Evaluation Plan further specified the format and procedures for preparing Revision Specifications.

The fourth task in the contractor's methodology involved Implementation Planning. This two-month effort was performed after Evaluation Planning and Instructor Training Course Development, using inputs from both. Major inputs were also derived from the instructional systems design, the syllabus flow charts, and the course materials. Squadron resources and constraints were particularly important considerations in this task. The effort was conducted primarily by the contractor's IP's, with squadron management in a significant consulting role. The resulting Implementation Plan provided a detailed description of the training system, the required resources, the organization and functions of the personnel involved, and a proposed implementation schedule. Key features of this plan were a conceptualization of the Student Learning Center (SLC) and guidelines for scheduling student flow through the system.

The fifth task in the contractor's methodology involved Instructor Training Course (ITC) Development. This was a four-month effort conducted by the contractor in two phases: course development and seminar implementation. The development effort was a function of contractor IP's, while the seminar implementation involved contractor IP's and SME's, Training Development Department (TDD) personnel, and squadron instructors. The course development utilized input from generic materials previously developed by the contractor (and used for SME training), and the Implementation and Evaluation Plans. Key features of the course centered on instructor roles in the conduct of training and in the evaluation/revision process. The course was conducted on six different occasions to allow all squadron personnel the opportunity to attend. While the ITC was first implemented as a three-day seminar detailing the overall ISD process, subsequent evaluation resulted in revisions to the presentation strategy. Subsequently, the course was presented in a one-day format focusing more exclusively on instructor roles and directing further study of the instructional materials.

The sixth task in the contractor's methodology consisted of Implementation and Evaluation. All of the previously described tasks contributed to this effort. The contractor's IP's and training analysts worked closely with the TDD's and the Operations Departments. While delays in the Instructional Materials Developed effort impacted significantly on implementation, the effort was accommodated within the contract period and all E-2C training materials were available as required. A phased implementation with some individualized instructional materials remaining temporarily in the classroom setting, was necessary, however, for E-2B implementation. One additional factor, which impacted on Instructional Materials Development as well as Implementation, was a delay in the delivery of the E-2C Operational Flight Trainer (OFT). An intermediate syllabus relying more heavily on E-2 flights and the CPT was designed and developed to accomodate this problem. The impact on Evaluation was to delay completion of summative data collection for an additional year, while formative data collection was accommodated within the contract period.

The seventh task, Revision Consultation, was performed by the contractor's IP's and training analysts concurrent with Implementation. Evaluation data provided inputs for this process. Revision specifications were prepared to assist in "fine tuning" the system and to update the training program in accordance with external hardware and software changes. A detailed revision documentation system was further developed to facilitate the process.

The eighth and final task in the contractor's methodology involved the collection of Resource Utilization Data for future planning purposes. This effort spanned the entire contract period, taking inputs from Navy as well as contractor resource expenditures. Man-hours and funds expended by task were documented along with other relevant data. Weekly time-slips were prepared by both Navy and contractor personnel.

SECTION III

IMPLEMENTATION

ORGANIZATION AND STAFFING

A summary of the overall Phase II project organization and staffing is depicted in Figure 5. General direction for the project came from the NTEC project monitor, who coordinated the efforts of RVAW-120, RVAW-110, and the contractor. Instructional Psychologists from the contractor's Human Factors Section provided overall planning, project management, technical direction and consultation support, as well as the preparation of all report documentation (e.g. Evaluation Plan, Implementation Plan, Progress Reports). The contractor's Principal Investigator was located at RVAW-120 NAS Norfolk. Assisting him at that site were two IP's (who primarily contributed to the ATSS, ITC and evaluation tasks), an NFO SME, a technical writer/editor, a narrator, and clerical personnel. Off-site contractor support for the project was provided by a pilot training consultant (IP) who had played a significant role in the Phase I analysis and design effort, an E-2B pilot SME located at RVAW-110 NAS Miramar, and media specialists and graphic arts personnel at the contractor's main facility in Buffalo, New York. An IP, assisted by a technician, coordinated the production effort. A total of 7 illustrators, assisted by photographic services personnel, were ultimately involved in the primary sub-task, tape/slide lesson production.

SME support for Instructional Materials Development was provided by RVAW-120 and RVAW-110. A separate Training Development Department or ISD Department was established at the E-2C and E-2B squadrons, respectively. The Training Development Officer (TDO) for RVAW-120 and the ISD officer for RVAW-110 provided a point of contact for the contractor's principal investigator and support personnel, and managed the efforts of a team of E-2B and E-2C pilot SMEs and E-2C NFO SMEs. Additionally, RVAW-120's TDO functioned as the training model manager. The manpower level and the composition of the departments fluctuated throughout the project, as a result of program demands, squadron constraints, and turnover of Navy personnel. Not depicted in Figure 5, but of equal importance to the project, was coordination with the squadrons' Safety and Operations Departments for Instructional Materials Development and Implementation. Man-hours by task for both contractor and Navy personnel are presented in Section V of this report.

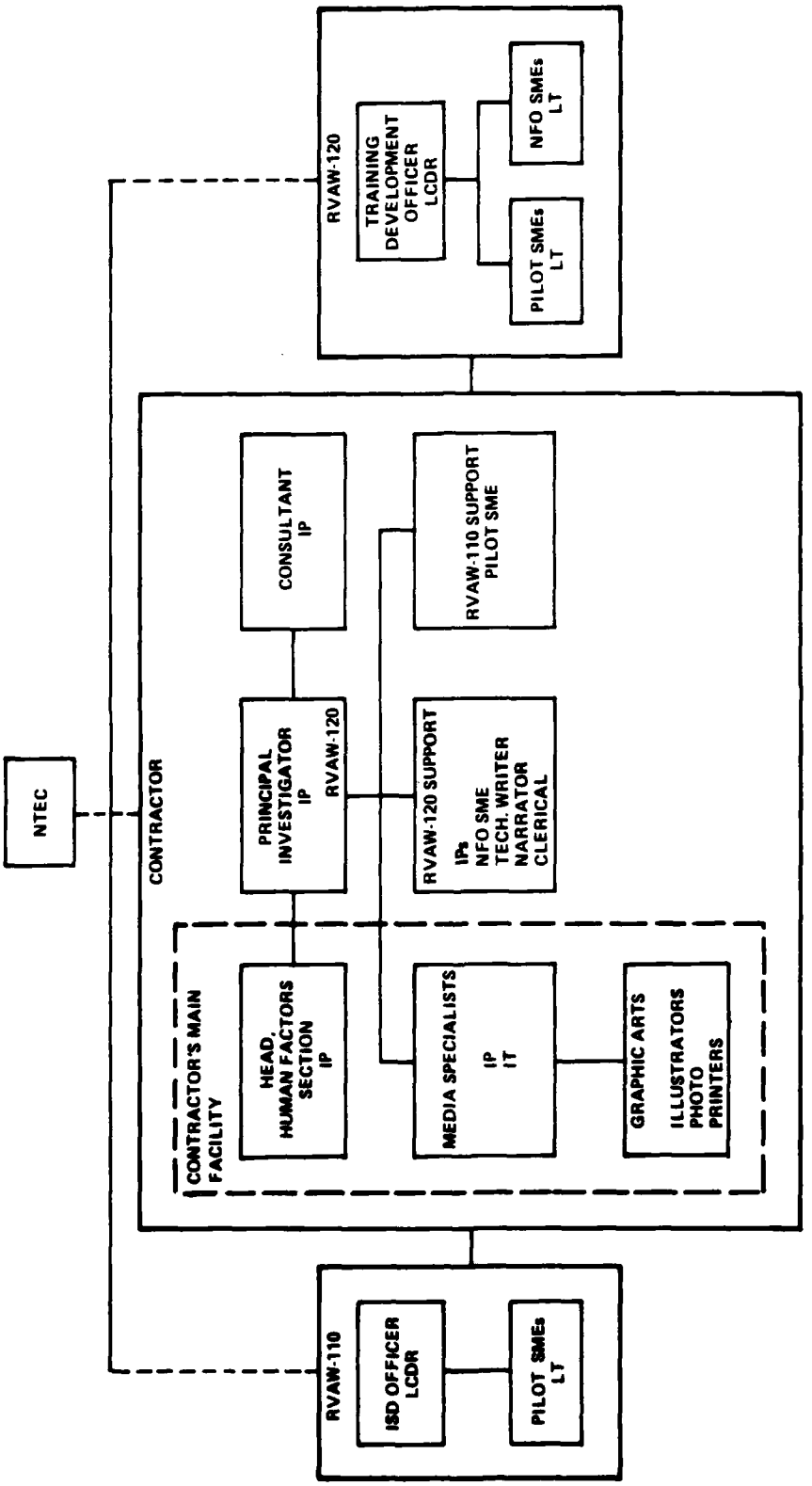


Figure 5. Project Organization and Staffing

CURRICULUM

SYLLABUS. Instructional materials were developed to support three types of training for E-2C pilots/copilots, E-2C NFOs/FTs, and E-2B pilots/co-pilots: cognitive lessons, practice lessons, and sortie/scenario lessons. The cognitive lessons present the "enabling" academic information via the primary medium of tape/slide lessons, the secondary medium of classroom lecture/discussion lessons, or the supplemental medium of assigned readings in technical publications. The individualized tape/slide lessons employ a high degree of visual fidelity, focusing on a control-display orientation. The "need-to-know" systems information and mission orientation are then programmed into this context. Within the NFO curriculum, this approach is reflected in an emphasis toward operator interaction with the computer software.

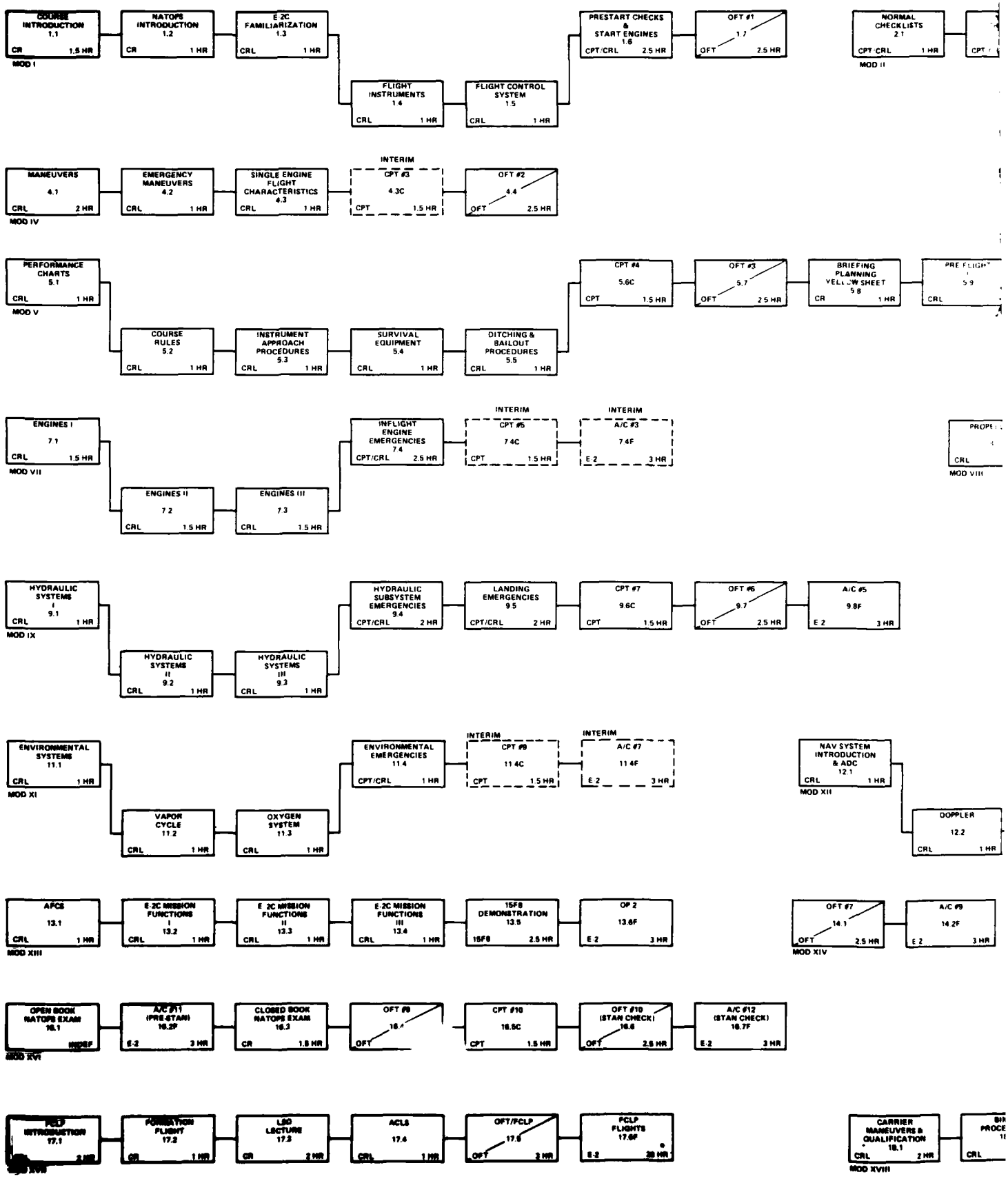
Lesson specifications were adapted for use as student handouts in support of the tape/slide lessons. For classroom lecture/discussion lessons, however, documentation was developed in the form of detailed lesson guides for both instructors and students. These lessons reflect a greater depth in mission background and the tactical task situation as well as an overview of essential theory. Supplementary media for these lessons are in the form of overhead projector transparencies.

Practice lessons involve "hands-on" performance training in the Cockpit Procedures Trainer (CPT) for the pilots and in the Weapon Systems Trainer (WST) for the NFOs/FTs. These lessons involve psychomotor skills development which builds upon the prerequisite cognitive lessons. A fully proceduralized CPT Syllabus manual (based upon the Behavioral Objectives) was developed to support these exercises for pilot training. Similarly, step-by-step directions were developed in the form of individual student handouts for NFO/FT practice training.

Sortie/Scenario lessons draw upon the knowledges and skills toward which the cognitive and practice lessons are directed. Simulation of actual mission performance is provided in units of increasing complexity. These lessons are conducted in the Operational Flight Trainer (OFT) and the E-2 aircraft for the pilots and in the WST and the E-2 aircraft for the NFOs/FTs. Training materials developed for these exercises consist of Flight Manuals for both pilots and NFOs.

Block flow charts in Figures 6 through 9 describe the primary ISD-based pilot and NFO/FT syllabi and associated collateral courses. These flow charts present linear tracks, with secondary levels indicating lesson sequences with interchangeable ordering. The sequence is ordered by lessons represented by connecting blocks and organized into modules. Each lesson block in the flow charts identifies the content, the medium, and the nominal instructional time to criterion. As a general rule, the recommended sequence by lesson and by module must be followed, but with two exceptions:

(1) If a trainee reaches criterion on the entire cognitive sequence of a module and then finds the trainer unavailable for a practice or sortie/scenario lesson, he may be allowed to proceed into the cognitive lessons in the next module;



* FCLP AND CQ FLIGHTS HOURS ARE ROUGH ESTIMATES ONLY

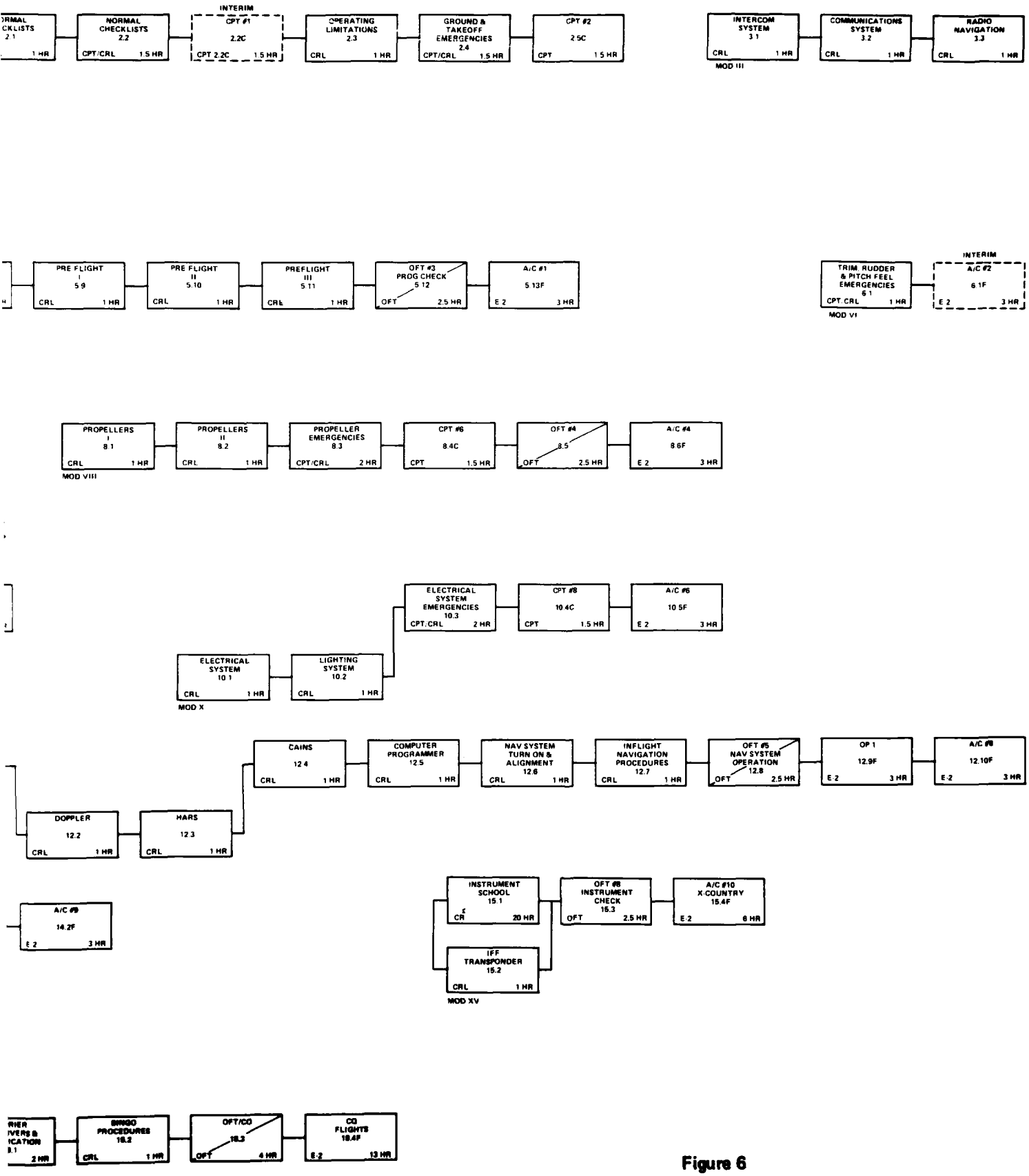
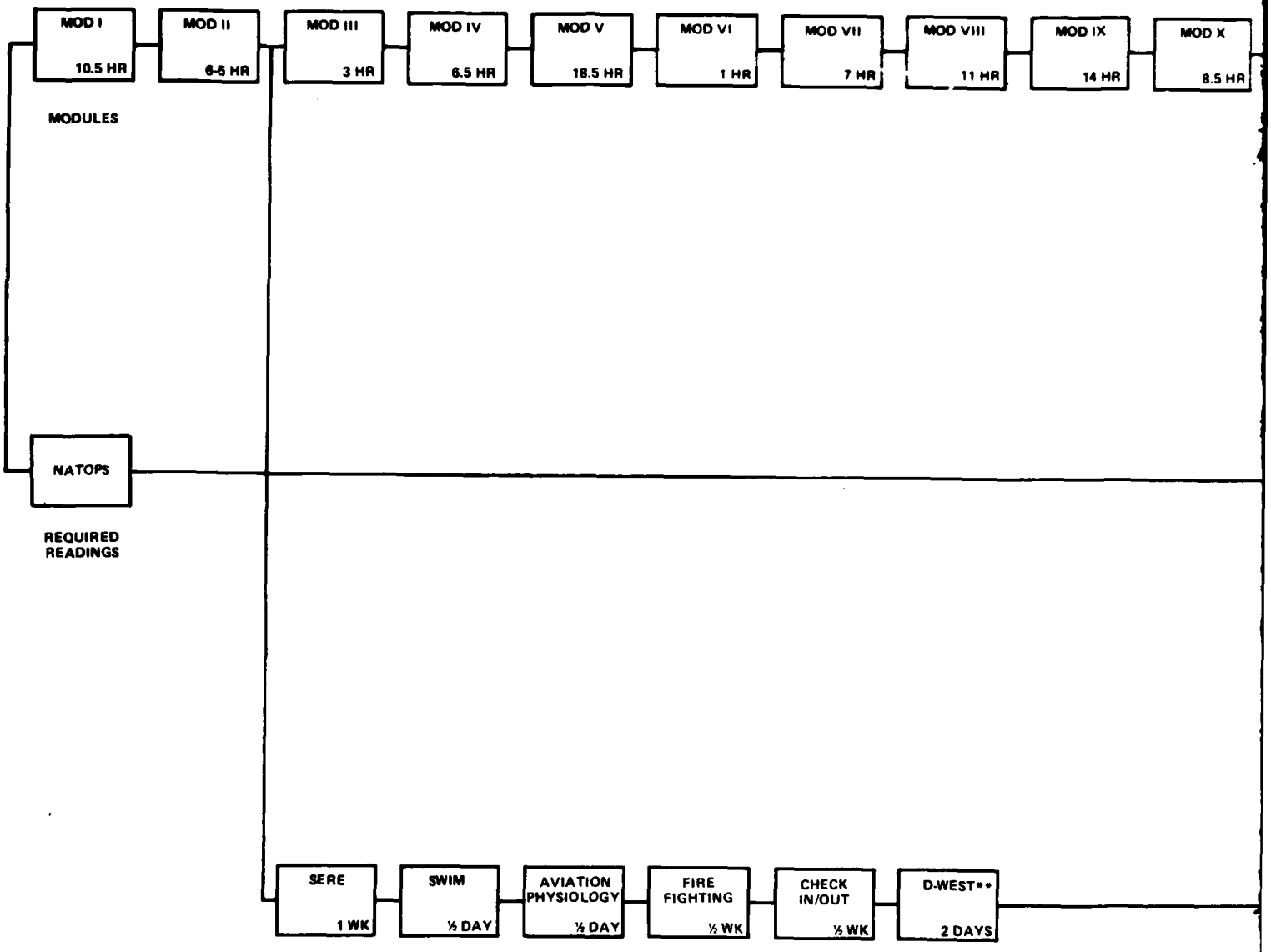


Figure 6

BLOCK FLOW CHART: PILOT/COPILOT PRIMARY TRACK SYLLABUS (May 1978)



* = FCLP AND CQ FLIGHTS (MODS. XVII AND XVIII) ARE ROUGH ESTIMATES ONLY
** = WEST COAST ONLY

Figure 7

PILOT/COPILOT MODULAR SEQUENCE WITH
(May 1978)

1

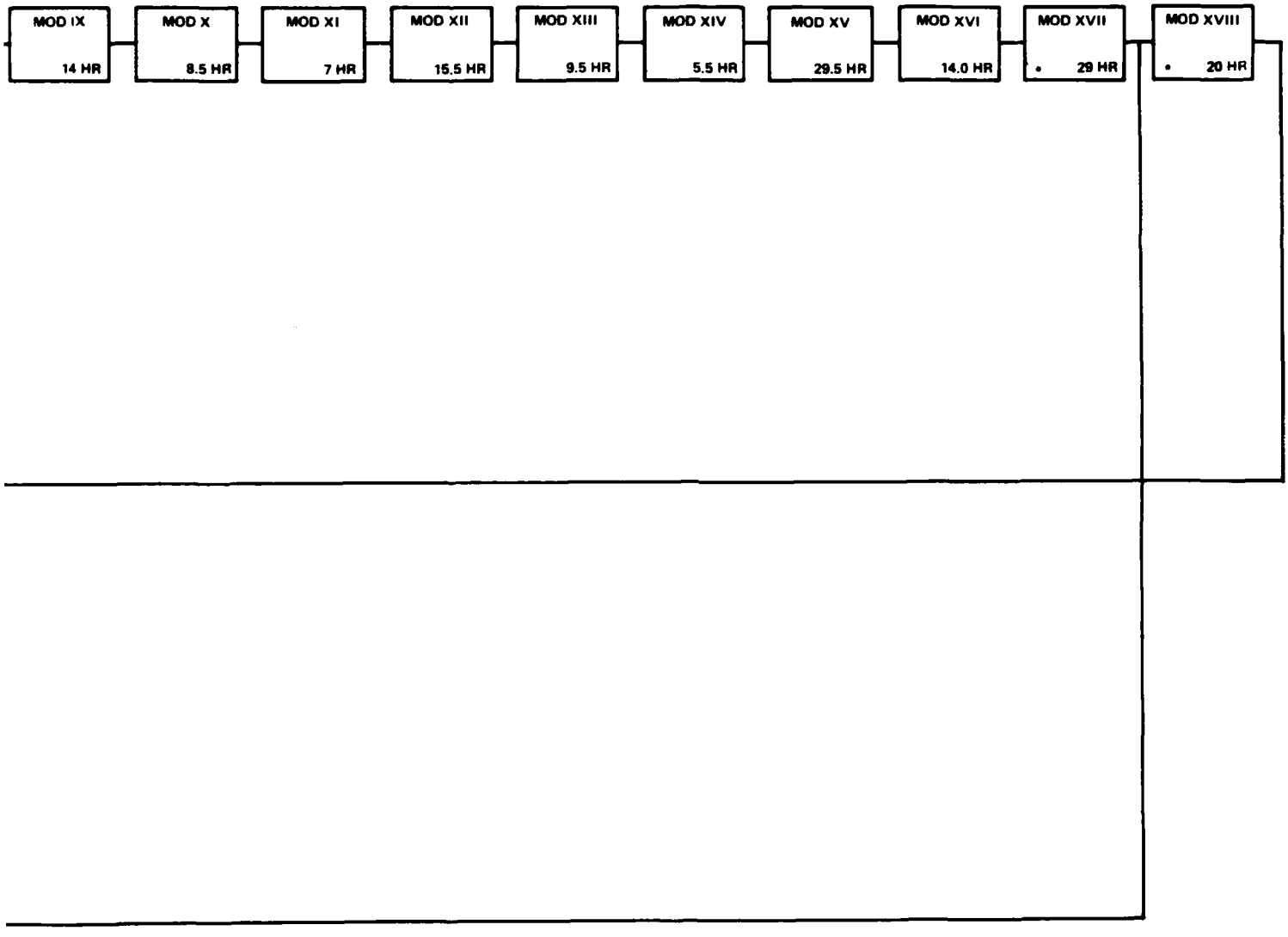
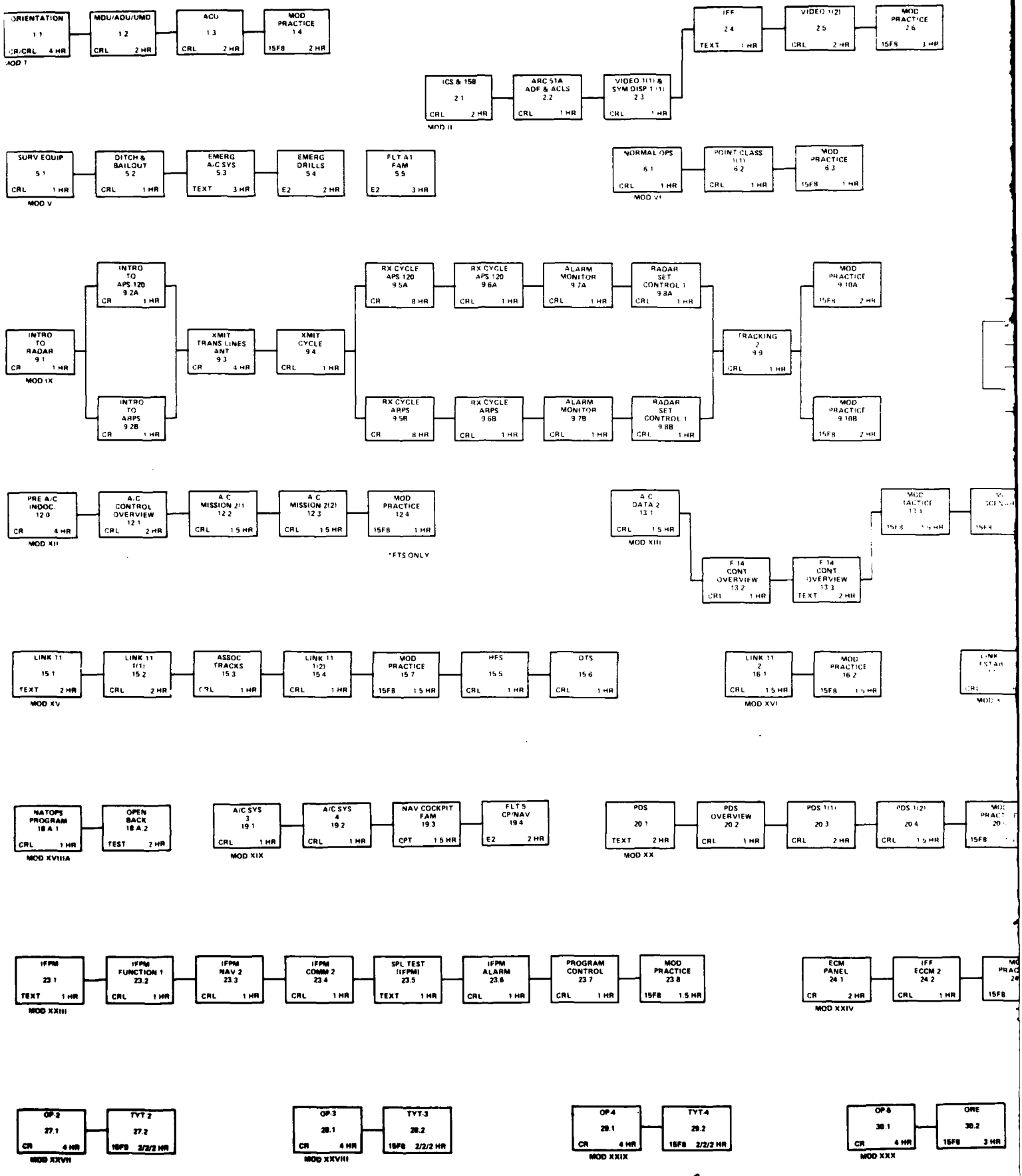


Figure 7

ULAR SEQUENCE WITH COLLATERAL COURSE
(May 1978)


ORIENTATION 1.1 CR/CRL 4 HR
MDU/ADU/UMD 1.2 CRL 2 HR
ACU 1.3 CRL 2 HR
MOD PRACTICE 1.4 15F8 2 HR
MOD I
ICS & 15B 2.1 CRL 2 HR
ARC 51A ADF & ACLS 2.2 CRL 1 HR
VIDEO 1(1) & SYM DISP 1 (1) 2.3 CRL 1 HR
IFF 2.4 TEXT 1 HR
VIDEO 1(2) 2.5 CRL 2 HR
MOD PRACTICE 2.6 15F8 3 HR
MOD II
SURV EQUIP 5.1 CRL 1 HR
DITCH & BAILOUT 5.2 CRL 1 HR
EMERG A/C SYS 5.3 TEXT 3 HR
EMERG DRILLS 5.4 E2 2 HR
FLT A1 FAM 5.5 E2 3 HR
MOD V
NORMAL OPS 6.1 CRL 1 HR
POINT CLASS 1(1) 6.2 CRL 1 HR
MOD PRACTICE 6.3 15F8 1 HR
MOD VI
INTRO TO RADAR 9.1 CR 1 HR
INTRO TO APS 120 9.2A CR 1 HR
INTRO TO ARPS 9.2B CR 1 HR
MOD IX
XMIT TRANS LINES ANT 9.3 CR 4 HR
XMIT CYCLE 9.4 CRL 1 HR
RX CYCLE APS 120 9.5A CR 8 HR
RX CYCLE APS 120 9.6A CRL 1 HR
ALARM MONITOR 9.7A CRL 1 HR
RADAR SET CONTROL 1 9.8A CRL 1 HR
RX CYCLE ARPS 9.5B CR 8 HR
RX CYCLE ARPS 9.6B CRL 1 HR
ALARM MONITOR 9.7B CRL 1 HR
RADAR SET CONTROL 1 9.8B CRL 1 HR
TRACKING 2 9.9 CRL 1 HR
MOD PRACTICE 9.10A 15F8 2 HR
MOD PRACTICE 9.10B 15F8 2 HR
PRE A/C INDOC. 12.0 CR 4 HR
A/C CONTROL OVERVIEW 12.1 CRL 2 HR
A/C MISSION 2(1) 12.2 CRL 1.5 HR
A/C MISSION 2(2) 12.3 CRL 1.5 HR
MOD PRACTICE 12.4 15F8 1 HR
MOD XII
*FTS ONLY
A/C DATA 2 13.1 CRL 1.5 HR
MOD XIII
F 14 CONT OVERVIEW 13.2 CRL 1 HR
F 14 CONT OVERVIEW 13.3 TEXT 2 HR
LINK 11 15.1 TEXT 2 HR
LINK 11 1(1) 15.2 CRL 2 HR
ASSOC TRACKS 15.3 CRL 1 HR
LINK 11 1(2) 15.4 CRL 1 HR
MOD PRACTICE 15.7 15F8 1.5 HR
HFS 15.5 CRL 1 HR
DTS 15.6 CRL 1 HR
MOD XV
LINK 11 2 16.1 CRL 1.5 HR
MOD PRACTICE 16.2 15F8 1.5 HR
MOD XVI
NATOPS PROGRAM 18.A.1 CRL 1 HR
OPEN BACK 18.A.2 TEST 2 HR
MOD XVIIIA
A/C SYS 3 19.1 CRL 1 HR
A/C SYS 4 19.2 CRL 1 HR
NAV COCKPIT FAM 19.3 CPT 1.5 HR
FLT 5 CP/NAV 19.4 E2 2 HR
MOD XIX
PDS 20.1 TEXT 2 HR
PDS OVERVIEW 20.2 CRL 1 HR
PDS 1(1) 20.3 CRL 2 HR
PDS 1(2) 20.4 CRL 1.5 HR
MOD XX
IFPM 23.1 TEXT 1 HR
IFPM FUNCTION 1 23.2 CRL 1 HR
IFPM NAV 2 23.3 CRL 1 HR
IFPM COMM 2 23.4 CRL 1 HR
SPL TEST (IFPM) 23.5 TEXT 1 HR
IFPM ALARM 23.6 CRL 1 HR
PROGRAM CONTROL 23.7 CRL 1 HR
MOD PRACTICE 23.8 15F8 1.5 HR
MOD XXIII
ECM PANEL 24.1 CR 2 HR
IFF ECCM 2 24.2 CRL 1 HR
MOD XXIV
OP-2 27.1 CR 4 HR
TYT 2 27.2 15F8 2/2/2 HR
MOD XXVII
OP-3 28.1 CR 4 HR
TYT-3 28.2 15F8 2/2/2 HR
MOD XXVIII
OP-4 29.1 CR 4 HR
TYT-4 29.2 15F8 2/2/2 HR
MOD XXIX
OP-5 30.1 CR 4 HR
ORE 30.2 15F8 3 HR
MOD XXX

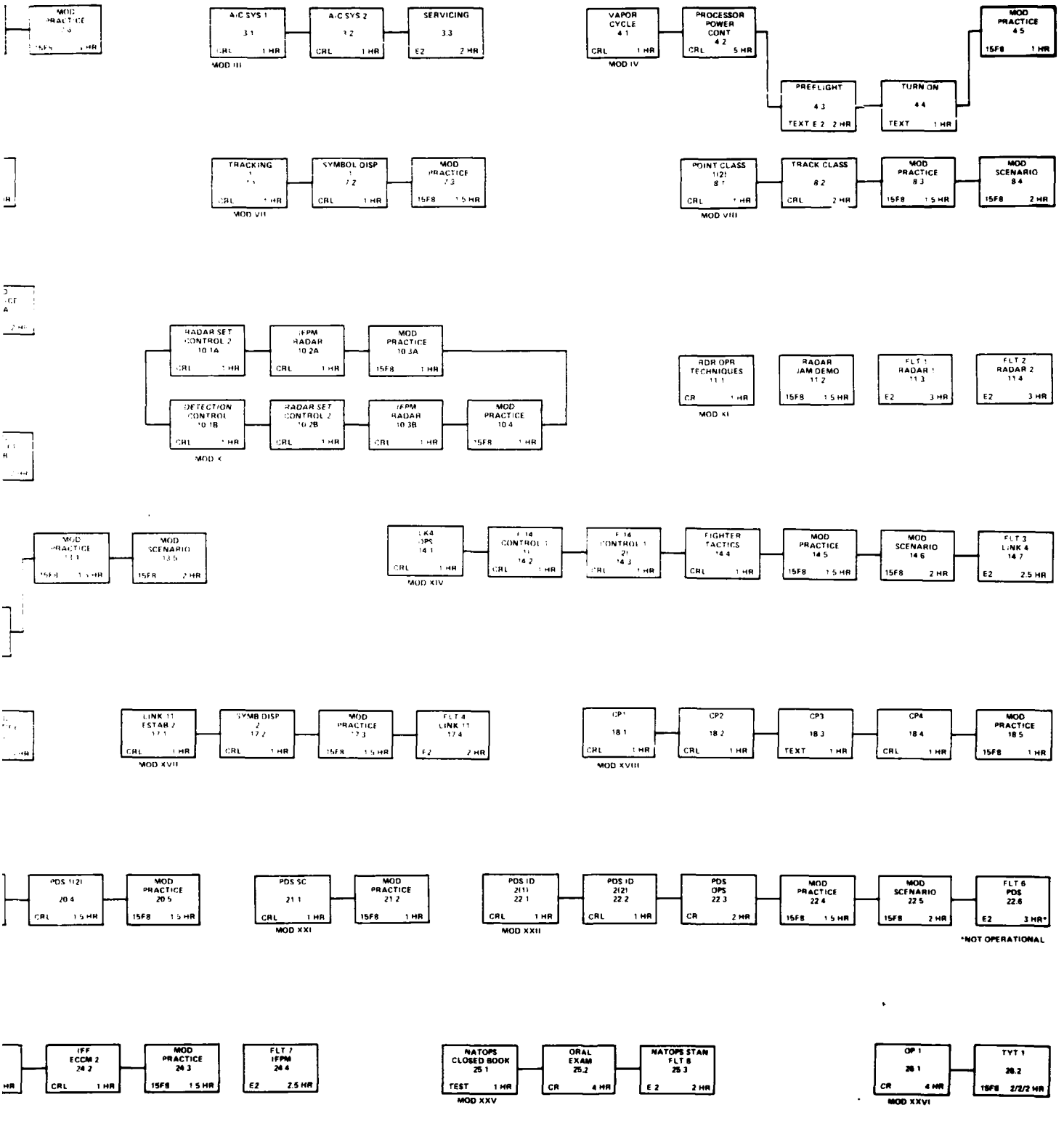


Figure 8 BLOCK FLOW CHART: NFO/FT PRIMARY TRACK SYLLABUS (May 1978)

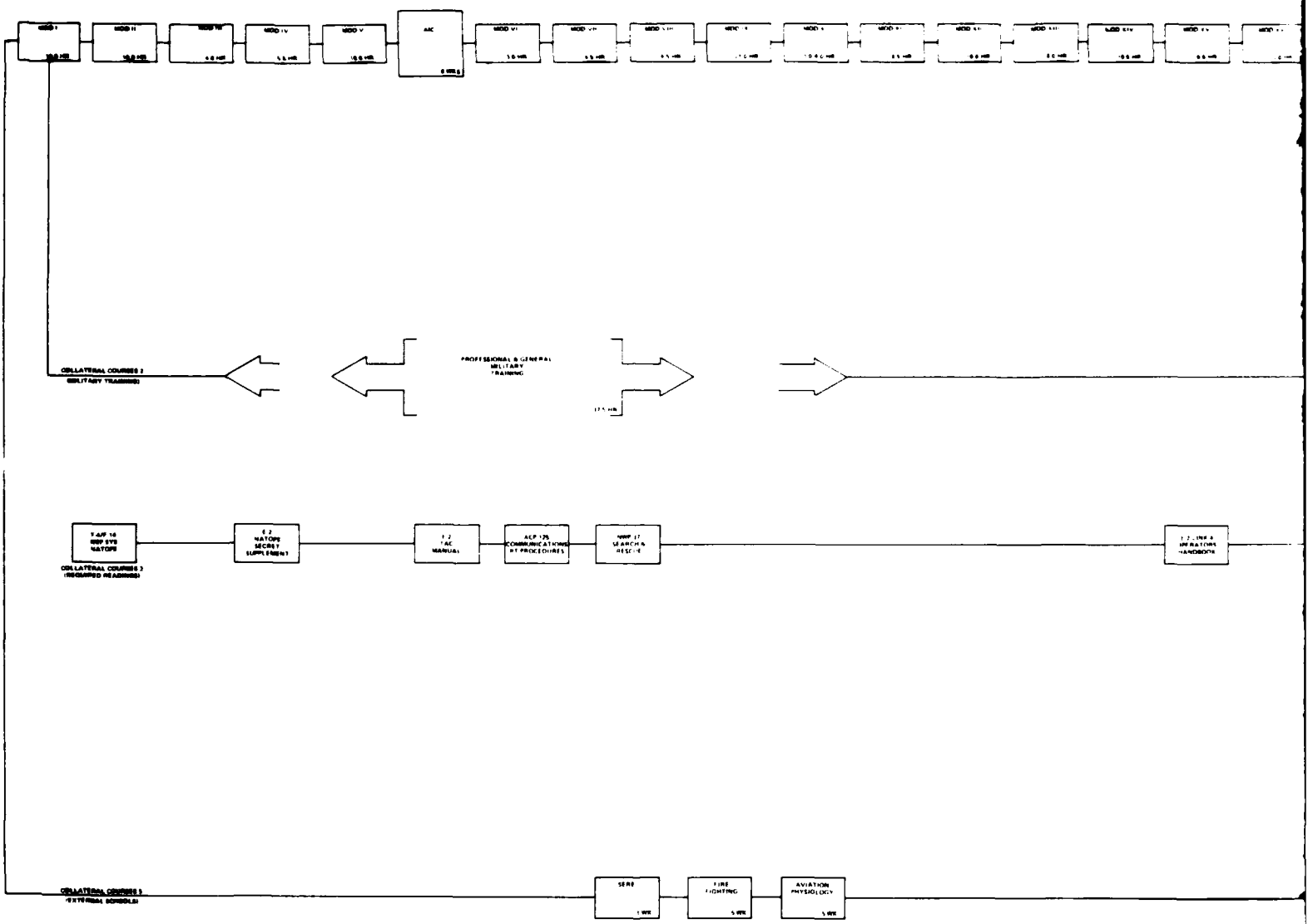
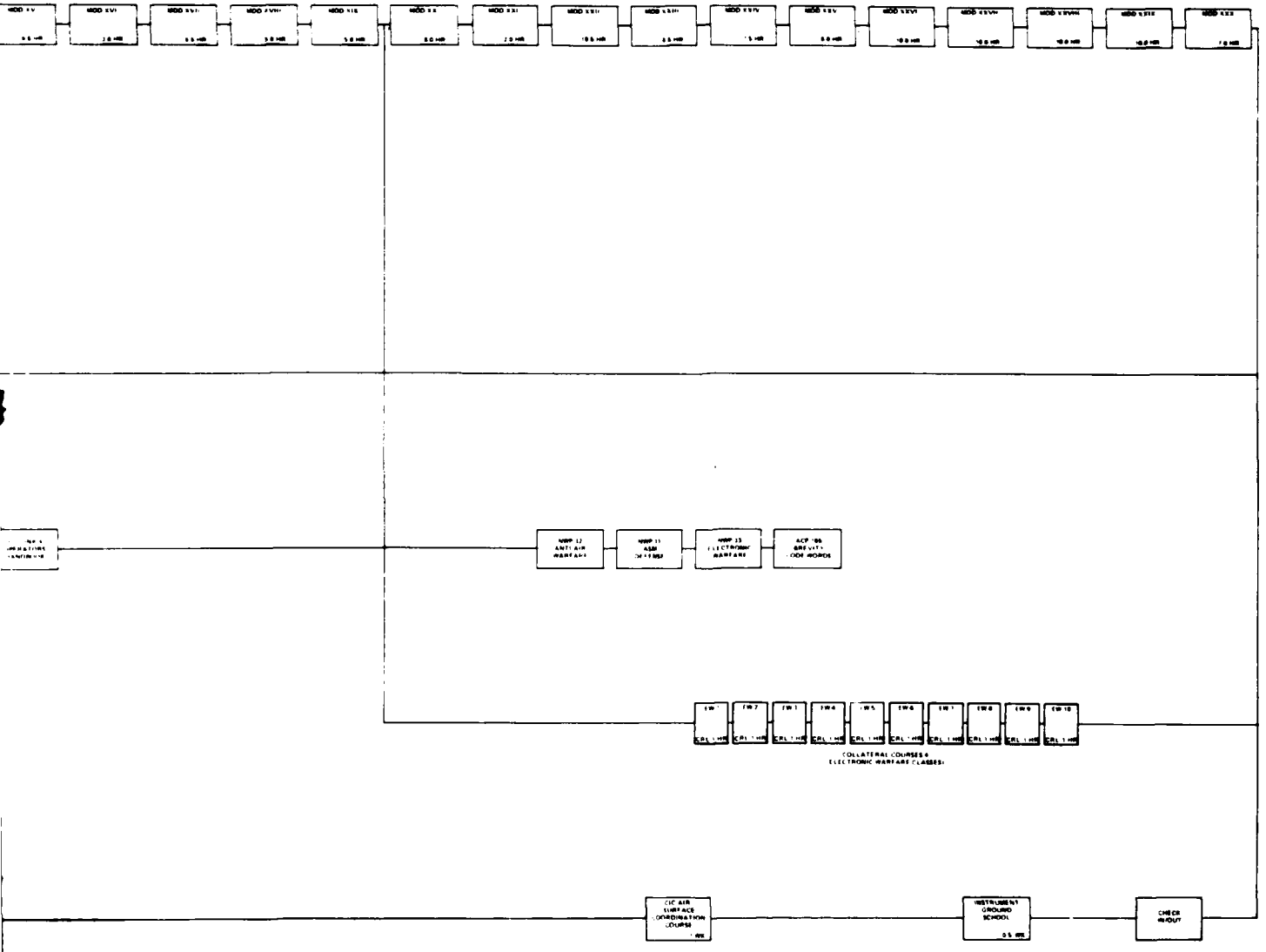


Figure 9

NFO/FT MODULAR SEQUENCE WITH COL
(May 1978)



re 9

E WITH COLLATERAL COURSES
978)

(2) Aircraft lessons may be completed up to two modules behind schedule, but may not be performed prior to completing all cognitive, practice and sortie/scenario lesson prerequisites. Additionally, it has been determined that the Field Carrier Landing Practice (FCLP) and Carrier Qualification (CQ) modules in the pilot syllabus may be undertaken earlier in the sequence (after Module XII) to meet carrier deck availability if required.

The above described syllabi are for trainees in Categories I and II. However, the modular structure allows for a reduced syllabus to meet the needs of trainees in special categories. This provision has been used to successfully accommodate E-2B to E-2C transition classes. It should be noted also that the FT syllabus eliminates the five tactical modules identified as the "OPS" phase.

Tables 1 and 2 further describe the syllabi by hours in each medium of the ISD-based syllabus. Additionally, the time for collateral courses is indicated. The entire curriculum can be completed in approximately 16 weeks for pilot training, and 26 weeks for NFO training.

TESTING. Each lesson in the training syllabus is concluded with a performance-oriented, criterion-referenced test. All test items are derived from the Behavioral Objectives. Cognitive testing utilizes chemically-treated, self-scoring answer sheets in the multiple-choice format. Practice and Sortie/Scenario testing relies on subjective assessments which are standardized through the use of a set of criteria derived from the Behavioral Objectives. The entire system is designed to assure and certify criterion proficiency on every Behavioral Objective prior to course completion. To record progress toward this proficiency, Student Record Sheets have been designed on a modular basis. Figure 10 presents an example from the pilot syllabus. Entries are made on time and number of errors to criterion for cognitive testing and pass/fail or "0-4" scale scores for Practice and Sortie/Scenario testing.

Viewing the cognitive testing procedure from the student's perspective, the process is as follows:

a. The student proceeds at his own pace in learning the information presented in a sound-slide lesson.

b. When the student is satisfied that he has mastered the objectives covered, he checks out a form of the corresponding cognitive test.

c. The student then attempts to answer a series of multiple choice questions by selecting the correct response on a self-scoring answer sheet.

d. As the student marks the chemically-treated coating of the answer sheet, he is given immediate feedback.

e. If he chooses an incorrect alternative, he continues to respond until correct.

f. The student reviews his errors and the corresponding instructional material.

g. Finally, he consults with the Learning Center Supervisor who prescribes remediation and/or tutors him until reaching the criterion performance level.

TABLE 1. ISD-BASED PILOT SYLLABUS BY HOURS IN MEDIA
(May (1978)

MODULE	CARREL	CLASSROOM	*OFT	CPT	CPT/CBT	ISIS	T-2	TOTAL
I	5.0	2.5	2.5		2.5			10.5
II	1.0			**1.5/1.5	4.0			8.0
III	5.0							5.0
IV	1.0		2.5	**1.5				8.0
V	8.0	1.0	5.0	1.5			3.0	18.5
VI					1.0		** 3.0	4.0
VII	4.5			**1.5	2.5		** 3.0	11.5
VIII	2.0		2.5	1.5	2.0		3.0	11.0
IX	5.0		2.5	1.5	1.0		3.0	14.0
X	2.0			1.5	2.0		3.0	8.5
XI	5.0			**1.5	1.0		** 3.0	8.5
XII	7.0		2.5				6.0	15.5
XIII	4.0		2.5			2.5	3.0	12.0
XIV			2.5				3.0	5.5
XV	1.0	20.0	2.5				6.0	29.5
XVI		1.5	5.0	1.5			6.0	14.0
XVII	5.0	5.0	5.0				* 20.0	29.0
XVIII	5.0		4.0				**15.0	20.0
	51.5	28.0	*37.0	9.0	19.0	2.5	69.0	216.0

*OFT NOT OPERATIONAL
* ESTIMATE FOR FCLP FLIGHTS

** TO BE DELETED WHEN OFT OPERATIONAL
** ESTIMATE FOR CQ FLIGHTS

COLLATERAL COURSES

PILOT COLLATERAL COURSES (Hours)

SERE SCHOOL	40.0
SURVIVAL SWIM	4.0
AVIATION PHYSIOLOGY	4.0
FIRE FIGHTING	20.0
CHECK IN/OUT	4.0
	72.0

TABLE 2. ISD-BASED NFO/FT SYLLABUS BY HOURS IN MEDIA (May 1978)

MODULE	CARREL	CLASSROOM	15F8	E-2	TEXT	TOTAL
I	-	1	2			10.0
II	6		3		1	10.0
III	2			2		4.0
IV	1.5		1	2	1	5.5
V	2			5		7.0
VI	2		1			3.0
VII	3		1.5		1	5.5
VIII	3		3.5			6.5
IX	3/3	14	2/2			21.0/21.0
X	2/3		1			3/4.0 (ARPS)
XI		1	1.5	6		8.5
XII	5	4	1			10.0
XIII	2.5	1	3.5		2	12.0
XIV	4		3.5	2.5		10.0
XV	6		1.5		2	9.5
XVI	1.5		1.5			3.0
XVII	2		1.5	2		5.5
XVIII *	3		1		1	5.0
XIX **	2			2		4.0
XX	4.5		1.5		2	8.0
XXI	1		1			2.0
XXII	2	2	3.5	3		7.5
XXIII	5		1.5		2	8.5
XXIV	1	2	1.5	2.5		7.0
XXV		4		2	1	7.0

TABLE 2. (CONTINUED)

MODULE	CARREL	CLASSROOM	15F8	E-2	TEXT	TOTAL
XXVI		4	6			10.0
XXVII		4	6			10.0
XXVIII		4	6			10.0
XXIX		4	6			10.0
XXX		4	3			7.0
	73.0/74.0	52.0	66.0	29.0	13.0	233.0/234.0

* (NATOPS) 1 Hour in CRL and 2 hours TEST

** NAV Cockpit FAM = 1.5 hours CPT

COLLATERAL COURSES (Secondary Tracks)

Aircraft Systems	5.5	NFO/FT
General Military Training	37.5	NFO/FT
Required Reading		NFO/FT
E. W. Classes	10.0	NFO/FT
SERE School	40.0	NFO/FT
Fire Fighting	20.0	NFO/FT
Aviation Physiology	20.0	NFO/FT
CIC Air/Surf. Coord.	40.0	NFO
Inst Ground School	20.0	NFO
AIC	240.0	NFO

IP's NAME _____ DATE ENTERED _____

SSN _____ DATE COMPLETED _____

LESSONS	COGNITIVE TESTS										PERFORMANCE TESTS					
	1st ATTEMPT					FINAL ATTEMPT					CPT 4 (5.6C)			FLIGHT 1 (5.13F)		
	DATE	NUMBER OF ERRORS # OUT OF #	%	TIME	INT	DATE	NUMBER OF ERRORS # OUT OF #	%	TOTAL # OF ATTEM	INT	1st ATTEMPT			1st ATTEMPT		
CRL 5.1 1 HR											PASS/FAIL	TIME	INT	COM/INC/UNSAT	TIME	INT
CRL 5.2 1 HR																
CRL 5.3 1 HR											FINAL ATTEMPT			FINAL ATTEMPT		
CRL 5.4 1 HR											PASS/FAIL	TIME	INT	COM/INC UNSAT	TIME	INT
CRL 5.5 1HR																
CRL 5.8 1HR											REMARKS			REMARKS		
CRL 5.9 1 HR																
CRL 5.10 1 HR																
CRL 5.11 1 HR																
	REMARKS															

Figure 10. Example Student Record Sheet from Pilot Syllabus

NAVTRAEQUIPCEN 78-C-0045-1

Practice and Sortie/Scenario testing is conducted by the Trainer and Aircraft Instructors with items prescribed via a checklist format. An example of the grading criteria from the pilot syllabus is presented below.

PILOT GRADING CRITERIA

0 -- Demonstrates lack of knowledge and/or prerequisite skills necessary to perform objectives.

1 -- Demonstrates knowledge of procedures, but performs objectives below the stated criterion with instructor assistance.

2 -- Performs objectives to the stated criterion level with instructor assistance.

3 -- Performs objectives to the stated criterion level without instructor assistance.

4 -- Performs objectives with accuracy and efficiency superior to the criterion level without instructor assistance.

These criteria are applied in variable fashion with #3 as the minimum graduating level. Grades 1, 2, 3 and 4 are referenced to the performance limits stated in the appropriate Behavioral Objectives. The grading criteria are supplemented with discrepancy checks for Basic Air Work and Procedures.

MEDIA. The general-purpose audio-visual carrel is utilized extensively throughout the pilot and NFO/FT syllabi as the medium through which the individualized cognitive instruction is presented. Cognitive lessons for both pilot and NFO/FT trainees are predominantly oriented toward the teaching of the knowledge necessary to operate the aircraft systems. The function of the general-purpose carrel in Figure 11 is to provide student-centered, individualized instruction that does not require active hands-on training. The carrels incorporate an audio-visual presentation and a work space for writing. The audio-visual presentations consist of a student-paced, narrated, slide presentation that is linearly programmed (i.e., without branching logic) but with a student-initiated synchronized review capability. At RVAW-120 there are a total of 19 carrels, of which 7 are installed in the Pilot Learning Center and 11 in the NFO Learning Center. The remaining carrel has been installed in the Training Development Department (TDD) office for use by TDD personnel in the ongoing evaluation and revision program.

Hands-on training devices are utilized for both pilot and NFO/FT training programs. These devices have been integrated throughout both the pilot and NFO/FT syllabi in such a manner as to provide early hands-on training. There are three ground-based training devices, one NFO and two pilot, through which hands-on training may be conducted. NFO hands-on training is accomplished through the use of the Tactics Trainer, device 15F8 (Figure 12). Pilot hands-on training utilizes both the Cockpit Procedures Trainer, device 2C20 (Figure 13) and the Operational Flight Trainer, device 2F110 (Figure 14). The E-2C aircraft itself (Figure 15) is also used for both Pilot and NFO/FT training.

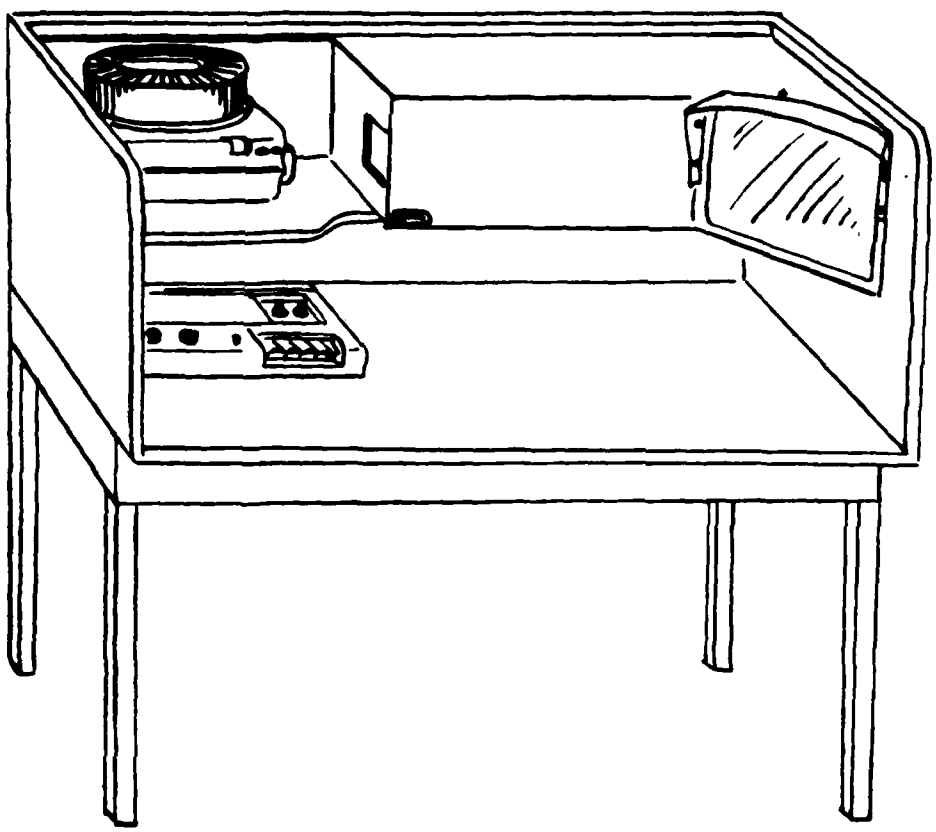


Figure 11. General-Purpose Carrel

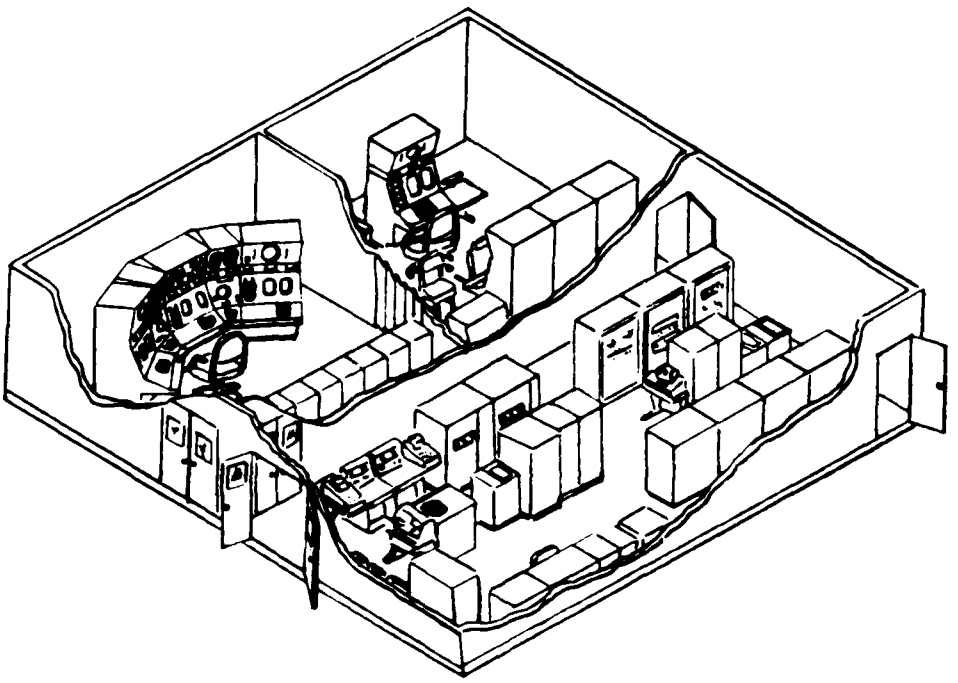


Figure 12. NFO/FT Tactics Trainer

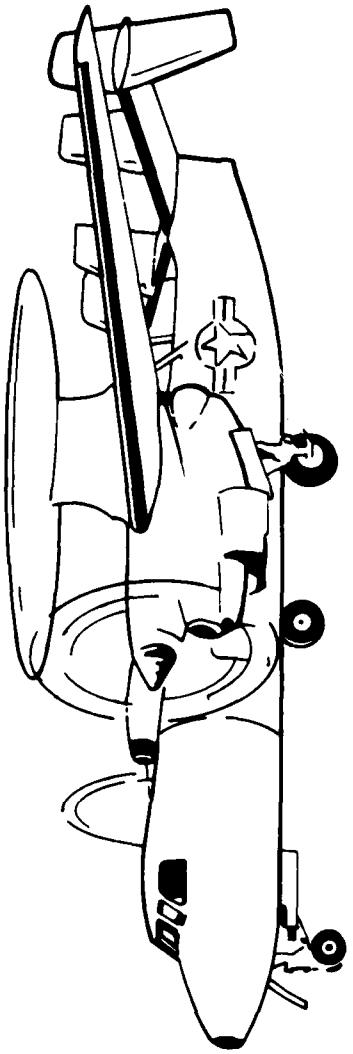


Figure 15. E-2C Aircraft

The 15F8 Tactics Trainer is a non-motion-base sophisticated state-of-the-art training device utilized by both NFO's and FT's to fulfill practice and scenario training requirements. The Tactics Trainer, which fully simulates the E-2C's CIC compartment, is capable of presenting preprogrammed scenarios to the trainees as well as full video, symbol and system alpha numeric generation for all modes of system operation. The simulated CIC compartment contains three student consoles: one for each of the CICO, ACO and FT stations. Also included within the simulated CIC compartment is a functional computer cabinet (OL-77) for the loading of standard tactical programs. Training may be accomplished on an individual or team training basis on any one of the three student consoles. Support instructor personnel will vary in accordance to the complexity of the tactical problem being run. Module practice sessions normally require between two and three support instructor personnel for student instruction and instructor console operation. The operationally oriented module scenarios require approximately four instructors, and Type Training (TYT) exercises and Operational Readiness Evaluation (ORE) scenarios require the full complement of seven instructors. The NFO/FT syllabus includes 30.0 Tactics Trainer hours devoted to module practice, 9.0 hours of module scenarios, 24.0 hours of TYT exercises, and 3.0 hours for ORE scenario training.

The Cockpit Procedures Trainer (CPT) is a computer-supported, fixed-base cockpit replica trainer which is uilized in the instruction and practice of both normal and emergency cockpit procedures. A maximum of two students may be accommodated during the practice sessions. One instructor is required to provide supervision and instructor console operation. With the advent of the ISD syllabus, a modification to the CPT has been made which allows for the use of audio/visual aids in conjunction with CPT operation. This modification provides the student at the pilot's station with the same audio/visual capability achieved with the general-purpose carrels. Additionally, the CPT audio/visual lessons were designed so that they may be utilized as "stand-alone" lessons in the learning center, should the CPT be unavailable or require maintenance. Trainees are scheduled for CPT practice sessions upon completion of the cognitive lessons within a module. The pilot syllabus includes 11.0 hours of CPT instruction; 19.0 additional hours augmented with audio/visual support. CPT instruction begins with the initial flight phase and covers all phases of flight procedures training through the NATOPS qualification phase.

The E-2C Operational Flight Trainer (OFT) is a major state-of-the-art trainer incorporating features to ensure realism and fidelity, training versatility, and pilot performance monitoring and recording. Realism is enhanced through faithful cockpit reproduction: A six-axis, six-degree-of-freedom motion base to provide proprioceptive cues. A visual, computer generated image system will provide carrier as well as field landing simulation. Aural simulation will also be extremely realistic through the reproduction of normal aircraft sounds which include engines, hydraulics, air stream and even ground power carts. Additionally, ground or carrier deck handling simulation, environmental conditions such as wind, rain and icing, as well as prerecorded ATIS broadcasts, complete the simulation and immerse the pilots in the training sortie. Also noteworthy is the fact that there will be more than 150 available malfunctions which will allow flight crews to see and deal with many situations which have heretofore been only discussed, because simulation in the aircraft was not possible or too dangerous. OFT flights account for 37 hours within the pilot syllabus and will cover all aspects of aircraft flight and

handling characteristics from the initial flight phases through the carrier qualifications phase.

Finally, the ultimate in hands-on training devices is, of course, the E-2C aircraft. The aircraft is considered to be a part of the media support because of the integrated flight syllabus for both Pilots and NFO/FT's. Through the use of the integrated flight syllabus, the traditional sequence of "ground school/flight syllabus" has been altered to provide early, optimally-spaced hands-on training throughout the entire syllabus. The pilot syllabus contains a total of 69.0 flight hours which are utilized to complete the entire flight syllabus. Of these hours, 36.0 are devoted to twelve aircraft flights, which begin with basic aircraft familiarization and conclude with NATOPS standardization. The remaining 33.0 hours are divided into field carrier landing practice flights (20.0 hrs) and carrier qualification flights (13.0 hrs.).

The NFO flight syllabus is also integrated and contains a total of 20 flight hours. It should be noted that there are 15 flight hours not reflected within the above figure that are dedicated to AIC training, which is considered to be a collateral course for the NFO's. The NFO flight syllabus consists of 9 flights, beginning with Radar and terminating with NATOPS standardization.

COMPUTER DATA BASE

The Instructional Systems Development Impact System Directory (ISDISD) was designed to facilitate a process of continuous revisions to the E-2C curriculum. By incorporating all ISD analytical documentation as well as source and curriculum documentation, the system provides a means of ensuring accuracy, completeness, and conformity to the systems approach to training. An overview of its design capability and examples of the data encoding formats used for the E-2C documentation are given below.

The ISDISD is a computer-managed information system which provides a directory of tasks, behavioral objectives, lessons, and hardware/software data. Numerous computer programs support and provide a means of maintaining, modifying, and displaying information pertaining to the hierarchically-structured Task Analysis Data Base, Behavioral Objectives Data Base, Lesson Data Base, and supplemental Hardware/Software Data Bases (NATOPS Flight Manual, Supplemental NATOPS Flight Manual, Software Manual, Tactics Manual, and Work Unit Code Manual). The structure of the three primary, on-line data bases (i.e., the Task Analysis Data Base, the Behavioral Objectives Data Base, and the Lesson Data Base) is a reflection of the Systems Approach to Training (SAT). As such, materials found in each succeeding data base are derived from materials provided by the preceding data base. In addition to this, the Hardware/Software Data Bases provide the Task Analysis Data Base with the necessary information concerning the E-2 system. Referring to Figure 16, the hierarchical arrangement of the on-line data bases and the manner in which the Hardware/Software Data Bases impinge upon the Task Analysis Data Base is schematically displayed. Additionally, this figure shows the linkages existing between the data bases and the subcategories of each data base.

The ISDISD has the capability of displaying and/or printing both the information contained in these data bases and the linkages between these data bases. This is accomplished through an interactive, on-line query process. Given a change of information in any of the system's data bases, whether proposed or actual, ISDISD will answer the following: What tasks are affected? What questions and objectives for those lessons are affected? What media, lesson plans, and other course materials are affected? Where is the media located in the master file library so that it can be reviewed?

The information needed to build the data base can be placed on computer magnetic tape, 9-track 800-1600 BPI, ASCII format, and batch processed. Whereas this can be done through an on-line interactive system, the capability does exist to place the information on a tape cassette generated by a Xerox 800 word processing system. The elements in each data base are placed sequentially on magnetic tape, reading the data bases hierarchical structure top to bottom, left to right. On the magnetic tape, this hierarchical structure is seen in the left to right coding of data fields. The starting point and ending point of a data field is indicated by the placement of an asterisk at the start and finish of each field. Each level of the data base's hierarchical structure is comprised of two fields. The first field, initiated by the appearance of a letter and number, signifies the level being described and the number associated with the specific element identified at that level. This field is followed by an asterisk. Following this asterisk, the next field contains a brief description or name referring to the letter and number found in the first field. An asterisk is placed at the end

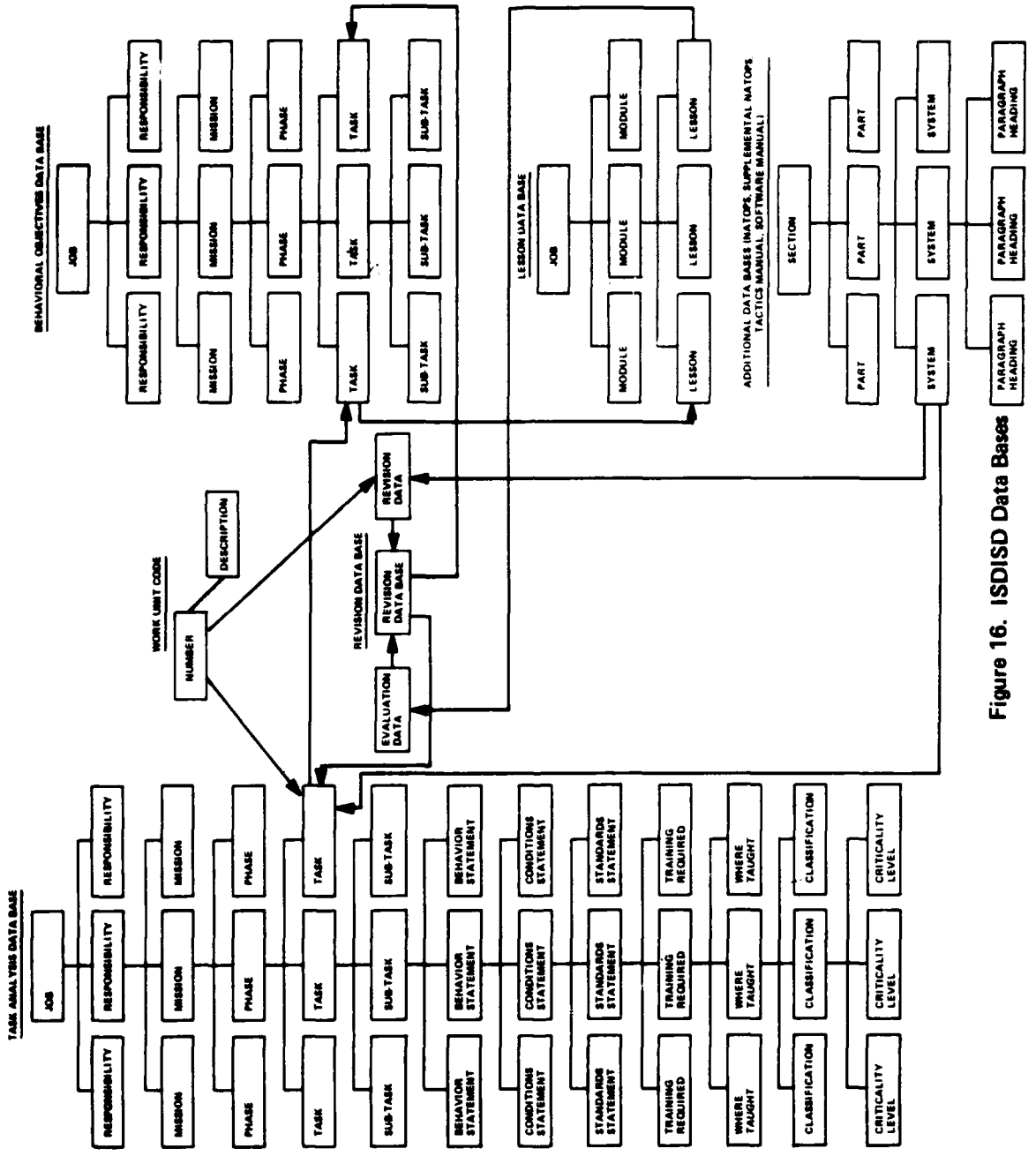


Figure 16. ISDISD Data Bases

of this descriptor, signifying the end of the second field and the beginning of the third. These two fields, (1) the letter and number, and (2) the descriptor, comprise the information needed to describe each level for a given data base. The rest of the data base's levels are described in a similar fashion.

Using the Task Analysis Data Base as an example, the corresponding symbology and field devices are described below:

FIELD TITLE	HIERARCHICAL STRUCTURE
JOB	J#* DESCRIPTION*
RESPONSIBILITY	R1**
MISSION	M#* DESCRIPTION*
PHASE	P1**
TASK	T#* DESCRIPTION*
SUBTASK	ST1**
BEHAVIOR STATEMENT	BS* DESCRIPTION*
CONDITIONS STATEMENT	CS* DESCRIPTION*
STANDARDS STATEMENT	SS* DESCRIPTION*
TRAINING REQUIRED	TC#*
WHERE TAUGHT	WT#*
CLASSIFICATION	CC#*
CRITICALITY LEVEL	CL#*

To an initial on-line query, the computer will print out information up to and including the TASK level.

An example of placing the records on a tape would be as follows:

J1* description* (NOTE: the asterisk starts and ends a field) R1* description* M1* description* P1* description* T1* description* BS* description* CS* description* SS* description* TC3* WT1* CC2* CL3* (the next record would start here) 9T2* description* BS, CS, etc., for this task T3* description* (additional data) P2* description* ¶# description* (additional data) etc. In other words, given a J#, R#, M#, and P#, every task would be listed under that P#; then the next P# and all the task under that, until the phases were completed; then a new M#, the first P# under that; all the T# under that P#; next P#, etc., etc.

Identical tasks and sub-tasks, with their related data, are often used in various places in the task track. ISDISD provides a method to handle this situation without duplication of data. For example, a task and its related data that has already been placed in the data base can be referenced by this format when entering a new task: J#* R#* M#* P#* T#* X J#* R#* M#* P#* T#*. If a new task is added, it would be normal to have the description after the * of the T#. However, in this case, X after the * tells the computer program that it is a cross-reference to a prior J#, R#, M#, P#, and T#. Pointers will then be set up by the computer to point to the T# description, BS, CS and SS description, and TC#, WT#, CC# and CL# of the original record. Any number of cross-references can be made to the original record. If the original record is deleted, it is cross-referenced by other T#'s. The basic device for cross-referencing is the pointer or index number. These consist of a series of the first field, i.e., letter and number, caricatures for each level of the data base. Whereas those pointers could conceivably index all levels of the data, this is not the case. Pointers index only to the level at which linkages between linking the Task Analysis and Lesson Data Bases occur at the TASK level of the former and the LESSON level of the latter.

In that the ISDISD is a computer-based system, it easily manages the complex Instructional Systems Development (ISD) training program. It effectively deals with a multitude of varied changes that could affect any data base and impact the instructional process. With the capability of providing either on-line or print-out information for all the data bases, this system facilitates the maintenance and modification of ISD data bases. A major benefit of this system is that it does not place any restrictions on any of the data bases as to the depth of the hierarchically structured levels, and it allows the use of any numbering system to identify elements at the different levels of each data base. Additionally, the combination of the ISD's hierarchical structure and its coding system offers a viable device by which the various data bases can be cross-referenced.

While the ISDISD data bases were encoded for the specific use of facilitating the maintenance and revision of the E-2C ISD program, the conceptualization and the supporting computer programs were designed for a more generic application. All ISD programs developed in accordance with the MIL-T-29053 specification can make use of these programs and data encoding formats. In fact, the goal of generic utility was the primary factor in the design of the ISDISD, thus requiring the adaptation of the E-2C specific data to fit the specification's framework. Necessary adaptations were accommodated through the use of "dummy statements" and the restructuring of content within the contractor's Phase I data bases.

EVALUATION PLAN

Evaluation in a comprehensive ISD-based program must be directed toward both formative and summative measures. To be operationally feasible, these measures must then be integrated into an organized data base. Finally, evaluation must be tailored to the particular course structure and learning strategies inherent in the system under analysis. Such an evaluation system was designed for the E-2 aircrew training program. Measures of learning acquisition, retention, and transfer were integrated into a progression of cognitive, practice, and sortie/scenario type lessons. The evaluation system then provided for a sophisticated computer data base, the Aviation Training Support System with associated analytical programs. Figure 17 presents a model of the information flow within this evaluation system. Formative Evaluation is the initial development component which consists of Quality Control and Revision input to the Curriculum. Quality Control procedures involve the application of acceptance checklists to storyboard or other preliminary draft instructional materials, while revision is based upon lesson, modular, and course level data from materials tryout. Summative Evaluation provides Quality Control input to the Curriculum via Revision after the program has been implemented in its entirety. This component of the overall evaluation model serves the functions of both an internal and an external validation of the curriculum as well. The Aviation Training Support System provides the computer data base component of the evaluation model which forms the heart of the system. This data base begins with all ISD documentation leading to initial development of the curriculum and is expanded to include updates from system changes. An additional function of the ATSS, although not operational, would provide revision from Formative Evaluation and Summative Evaluation. These data sources are processed by the ATSS which documents and facilitates curriculum revisions and has the capability of providing validation reports to training management. The evaluation model presented in Figure 17 is further defined by a performance assessment strategy illustrated in Figure 18. This strategy applies to both formative and summative evaluation, with differences occurring only in data collection techniques and areas of emphasis. Each component of the strategy is briefly described below.

Formative Evaluation is applied to the three-part training strategy involving cognitive, practice, and sortie/scenario lessons in a continuum from learning acquisition to retention and transfer. In consonance with the performance-oriented approach to aircrew training upon which the E-2 ISD program has been based, learning is evaluated:

(1) in the cognitive setting where the academic prerequisites of a skill are developed;

(2) in the practice setting where the actual component skills are developed;

(3) in the sortie/scenario setting where skills are integrated and applied; and

(4) in the broader setting of course level objectives and criteria.

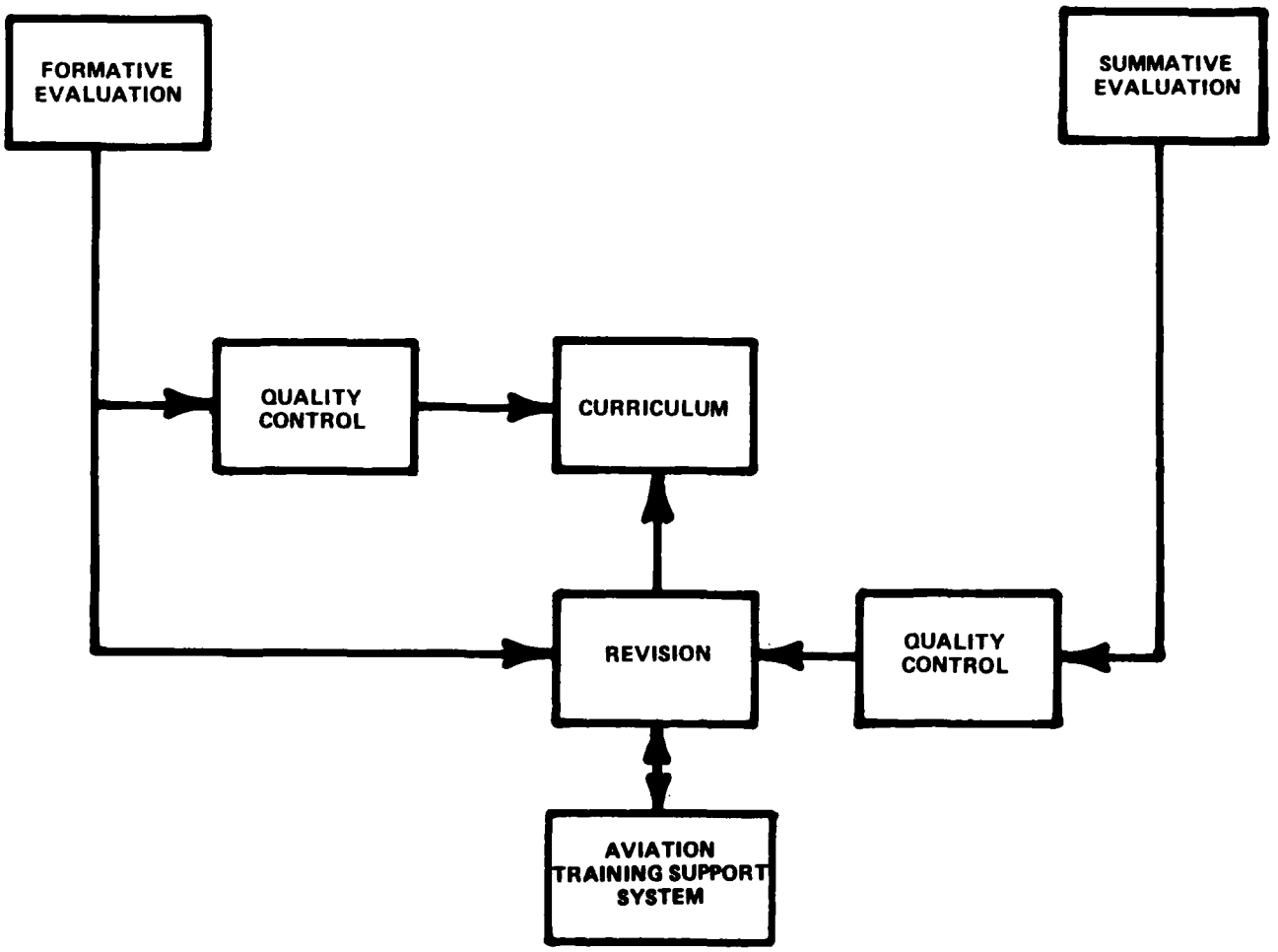


Figure 17. Evaluation Model

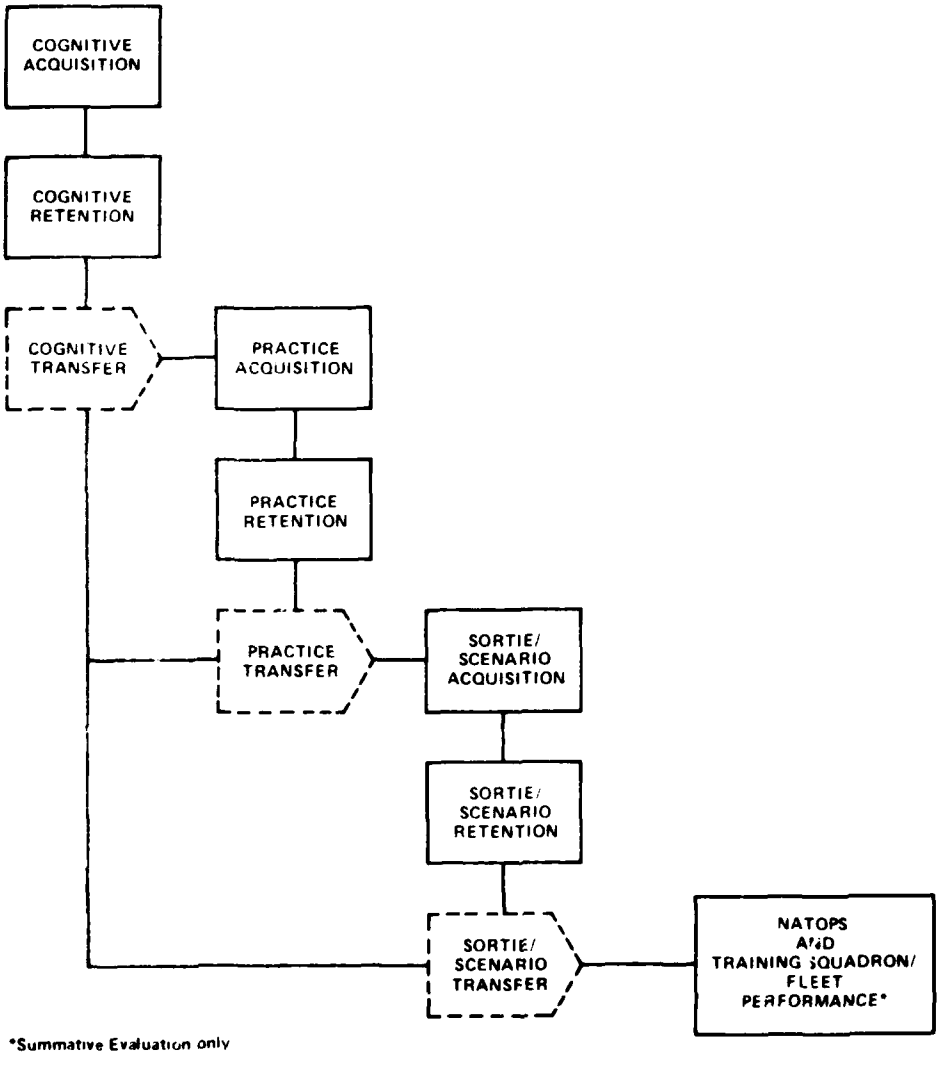


Figure 18. Performance Assessment Strategy: Formative and Summative Evaluation

The purpose of the overall Formative Evaluation is therefore a method of collecting and organizing data which contributes to curriculum development at the lesson level, but also at the modular, supra-modular, and course level. Thus, no data is viewed only in isolation. Rather, it is available for a systems approach to analysis.

Summative Evaluation is best viewed as a dual-purpose component of the overall evaluation system. One purpose is to provide training program validation against base-line data from the former training program and the fleet. The second purpose is to provide input to Management Feedback and Quality Control. The former purpose is achieved as the end-product of the fully implemented program and requires a comprehensive one-time data collection effort. The latter purpose requires a continuing activity and is one that periodically results in reports to management and revision to the curriculum. The Summative Evaluation strategy can be compared to the previously presented Formative Evaluation strategy, as the basic structure of learning types and learning sequences remains essentially the same. The only difference in evaluation structure lies in the absence of the Retention Component. While this component remains of interest to Summative Evaluation, it is subsumed under the Practice and Sortie/Scenario components where it takes on an adaptive function. The Summative Evaluation represents a shift not only from small group to large group data collection, but also from materials tryout to student performance. The former emphasis provided by Formative Evaluation contributes to curriculum development (including initial revision), while the latter emphasis contributes to validation, revision, and maintenance. Both Formative and Summative Evaluation are necessary, however, and can be particularly useful when integrated by such a Training Feedback mechanism as the Aviation Training Support System.

Data collection instruments and procedures were developed by the contractor and the SMEs to fulfill the requirements of both formative and summative evaluation. These instruments can be characterized as checklists, questionnaires, and tests. Questionnaires involved squadron and fleet feedback instruments as well as student attitude surveys. Test development procedures were designed to assure a criterion-referenced, performance-based orientation. The output of the overall data collection design was then integrated into a scheme for providing Revision Specifications.

IMPLEMENTATION PLAN

An essential requirement of any comprehensive ISD effort is the preparation of a logical and orderly implementation plan. The plan must focus on training management and administration personnel, procedures, and techniques. Such a plan provided the ISD management personnel with an overview of the proposed instructional systems, instructional systems integration procedure and schedules, specifications for the resources and operation of the Student Learning Centers (SLC), and role descriptions of training personnel. Feasibility as well as optimum instructional effectiveness were primary considerations in the formulation of these plans. Operational considerations were carefully incorporated to ensure a smooth transition from the existing to the revised instructional systems. These considerations were based on the best available projection data and were designed to accomodate the necessary flexibility within the range of normal operations. Then, too, potential constraints were identified and contingency plans were incorporated.

The implementation schedule began with projected completion dates for the developmental tasks and then provided for instructor training dates, class convening dates, and evaluation/revision task periods. Milestones were then established for facility and equipment readiness and "kickoff" meetings.

Specifications for the SLC were among the most important components of the plan. Figure 19 presents a conceptualization of the proposed squadron organization as it impacts on personnel and facilities operations. The hub of the SLC is the Student Records Section through which all trainee activities are coordinated. Primary functions of the Student Records Section are:

(1) to issue daily and weekly schedules (prepared by the Scheduling Section);

(2) to issue instructional materials (including tape/slide lessons);

(3) to maintain individual and master records of student performance in the carrel, classroom, trainers, and aircraft for tracking and evaluation purposes; and

(4) to ensure that each student progresses through the prescribed course on schedule and in the proper sequence.

The Scheduling Section has the primary function of preparing daily and weekly schedules for aircraft flights, trainers, and classroom sessions. Detailed scheduling of lessons designated for audio-visual carrels is not required. Instead, each student is responsible (as directed by the Student Records Section) for individually completing the carrel lessons which are prerequisite to the aircraft, trainer, and classroom lessons. Thus, close coordination between the Student Records Section and the Scheduling Section is essential. A series of tables indicating expected student progress by media and training day provide assistance in scheduling.

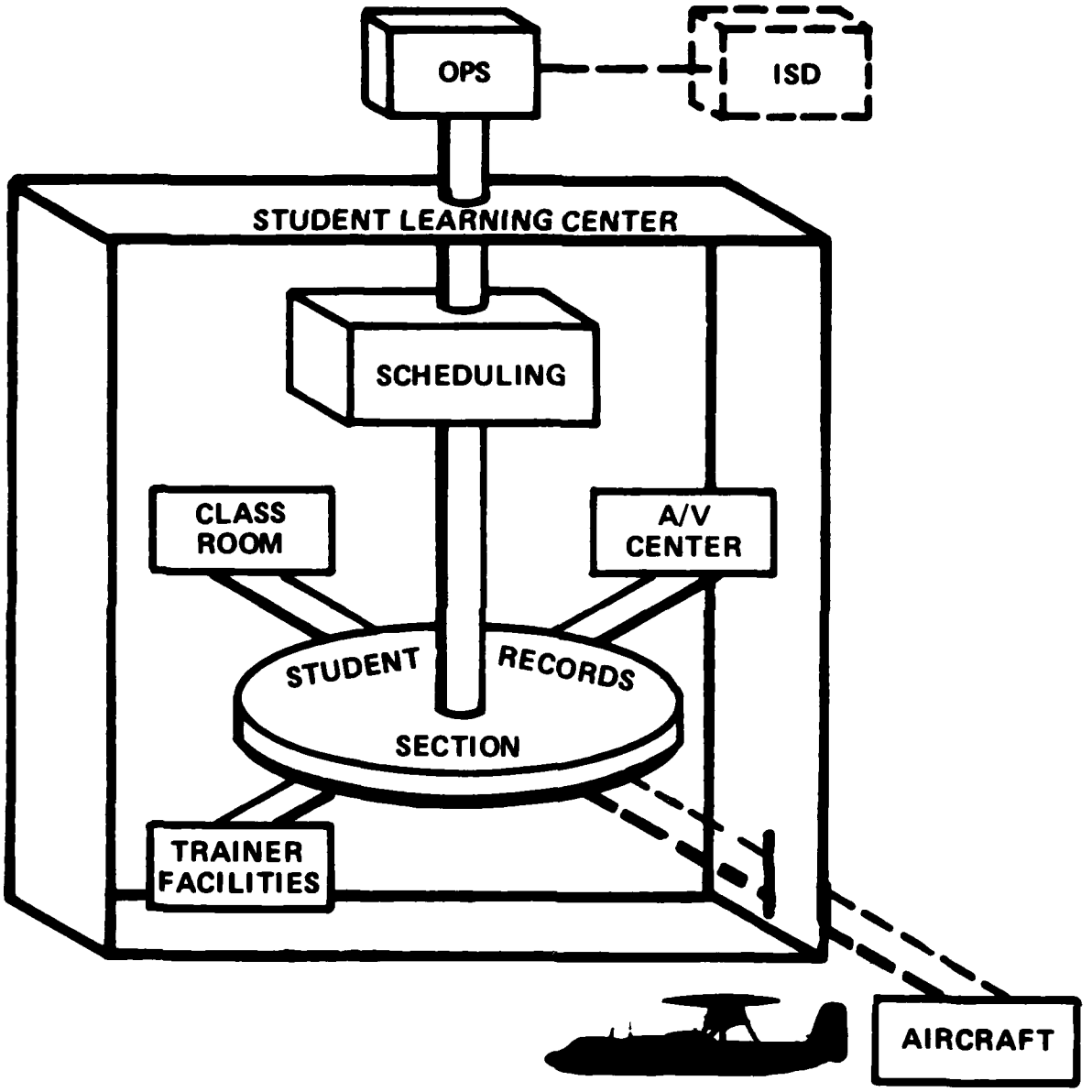


Figure 19. Instructional System Components

Traditional instructor roles are described for the Classroom, Trainer, and Aircraft components of the system. However, the A-V Center component is an innovation to E-2 training procedures. The A-V Center provides the environment for the primary instructional medium, the tape/slide. Within this environment, the student is seated at an individual carrel, where he proceeds through tape/slide lessons at his own pace. Upon completion of a tape/slide lesson, the student must reach criterion on a multiple-choice test before proceeding to another lesson. Fully qualified instructors designated as Learning Center Supervisor (LCSs) must be on duty within the A-V Centers throughout the training day. The role of the LCS is to assist the students with any learning problems encountered while viewing a tape/slide lesson (e.g. answer questions, provide clarification and amplification, etc.) as requested. More importantly, however, he reviews all incorrect test responses with the student and provides remediation as necessary. The LCS further provides reports to the ISD/Training Development Departments on problems encountered with the training system.

INSTRUCTOR TRAINING

A prime responsibility of the contractor was the training of SMEs for their roles in the authoring and revision tasks and the instructors for their roles in the operational instructional system. The former requirement was satisfied with the contractor's reference materials (i.e. "Guidelines and Readings in Instructional Technology" and "Instructional Technology for Aircrew Training") and on-the-job training under the supervision of the contractor's IPs, media specialists, and technical writers. These materials outlined the procedures for the entire ISD process, but focused heavily on "storyboarding" techniques for audio-visual presentations and test development procedures for multiple-choice items. The latter requirement, instructor training, was fulfilled via a seminar conducted by the contractor's IPs and training analysts. The seminar was centered around a lecture guide supported by overhead projector transparencies and individual student handouts. While the handouts incorporated the previously described SME authoring guidelines (primarily as self-study and reference materials), they and the seminar were more heavily oriented toward the roles of the instructors and the operation of the training system.

Table 3 presents the Table of Contents from the Seminar Instructors Guide. The first four sections, "Analysis and Design of ISD-Based Training Program," "Training System Description," "Training Operations," and "Performance Evaluation and Revision" are keyed to the needs of the instructor. Detailed instruction in these areas and an overview of the development/revision procedures precedes further self-study and on-the-job training. A fully qualified instructor must also become familiar with the content of the individualized aircrew training lessons, and must complete a standardization syllabus for trainer and flight exercises.

During the follow-on revision period, the instructor training syllabus was revised and expanded to include the following slide/tape presentations: "ISD Overview," "Instructor Roles," Training Operations," "Quality Control and Revision," "Conducting Trainer and Flight Exercises," "Lesson Authoring," "Storyboarding Techniques for Slide/Tape Presentations," and "Authoring Trainer and Flight Exercises." Many of these slide/tape presentations are of generic as well as E-2 specific utility. Additional instructional materials in support of the Instructors-Under-Training (IUT) syllabus included an Instructor's Manual, a Cockpit Procedure Trainer (CPT) Instructor's Manual, Pilot and NFO Instructors Flight Syllabi, and a series of slide/tape presentations on "WST Operations."

TABLE 3. TABLE OF CONTENTS: SEMINAR INSTRUCTOR'S GUIDE

IMPLEMENTATION AND EVALUATION

E-2C NFO implementation was initiated at RVAW-120, NAS Norfolk in November 1977. Initially, a six-man NFO class entered the ISD-based syllabus, followed by a three-man FT class in January 1978. While the NFO class entered the system first, their additional requirement of AIC training allowed the FT class to proceed several modules ahead of them in the ISD-based syllabus. This schedule allowed the FT class to serve as subjects in a formative evaluation concurrent with the fulfillment of their training requirements. Despite delays in production due to problems in obtaining the required level of Navy SME support, materials were available as required. Construction of the NFO Student Learning Center was completed ahead of schedule, but equipment problems with the tape players were encountered on a continual basis.

E-2C pilot implementation began in January 1978 with an E-2B-to-E-2C transition class. This transition class provided the opportunity for a comprehensive formative evaluation of many of the tape/slide lessons in the ISD-based syllabus. Prior to the first full-syllabus E-2C pilot class, it was determined that an interim syllabus would be necessary to accommodate a delay in the delivery of the OFT. Accordingly, greater reliance was directed toward the CPT and the aircraft flights. An Interim Flight Syllabus Guide and an Interim CPT Syllabus Guide were developed to meet these requirements. A pilot class was then convened in March 1978.

E-2B implementation at RVAW-110, NAS Miramar began in June 1978. Instructional materials for the E-2B pilots were available as needed. The impact of authoring delays in the E-2C syllabus (and subsequent E-2C-to-E-2B conversion delays) as well as low manpower levels of E-2B SME resources at that squadron resulted in a temporary reliance on classroom vs. individualized presentations for several lessons. An interim syllabus was also required to accommodate the lack of an OFT as in the E-2C implementation.

Implementation followed the procedures prescribed in the Implementation Plan, the Evaluation Plan, and the Instructor Training Course. On-site IPs and training analysts worked closely with the Navy ISD Departments where coordination was maintained with the operations departments. Monthly Progress Review Meetings proceeded throughout the implementation/evaluation period with emphasis on provisions for long-term revision support.

During the period of July 1978 through July 1979, contractor support was maintained to continue the summative evlaluation and to provide revision consultation and production support. Data collected during that period documented the requirement for a 20% revision effort to "fine-tune" the system. These revisions were of an iterative nature, covering the entire range of instructional materials and procedures. Additionally, hardware and software modifications in the E-2C required extensive content revisions to the instructional materials. This was particularly true of the NFO/FT syllabus, which had to accommodate the "C-3" software change. The revised NFO/FT syllabus is depicted in block flow-chart form in Appendix B.

REVISION CONSULTATION

The Phase II revision plan is a comprehensive program under which both formative and summative revisions are documented and reviewed for inclusion in both Pilot and NFO/FT syllabi. Formative revisions were first documented during the Materials Tryout period in which one class of E-2B transition pilots and one class of FT's participated. Discrepancies which were discovered during Materials Tryout were documented on "Revision Data Sheets" (Fig. 20)) for both audio-visual and printed materials discrepancies. These revision data sheets were subsequently reviewed and verified by Training Development Department (TDD) and contractor personnel. Discrepancies were then transcribed to the "Audio-Visual Revision Specifications" (Figure 21). The revision specifications were either forwarded to the contractor's Buffalo, N. Y. facility for the graphic corrections or retained on-site for narrative and printed material corrections. To provide for the interim period while the revisions are being completed, "Errata Sheets" (Figure 22) are provided with each lesson to identify pending revisions. In most cases, slides with minor discrepancies were not removed. However, if the discrepancy was evaluated to have a detrimental effect on the instructional value, the slide was then removed and a temporary filler slide was installed in its place.

Because of the overlap between the formal program implementation and the audio-visual production schedule, both formative and summative revision data were collected within the same time frame but not simultaneously. The "Formative-Summative Review" plan is shown in Figure 23. In accordance with the plan, the finished slides were shipped from Buffalo to the E-2C Project Office in Norfolk, Va. Once the slides were received in Norfolk, the audio-visual lessons were prepared for review and issued to TDD for subsequent issue to and evaluation by Pilot/NFO instructor personnel. During the review process, rough discrepancies were recorded on revision data sheets and then returned to the TDD for review and verification. Once the discrepancies were verified, a suggested revision was also recorded on the revision data sheet. The completed revision data sheets were returned to the contractor for documentation and the preparation of audio-visual revision specifications. It should be noted that whenever necessary, attachments were made to the revision specifications to allow for a detailed description of the correction to be made. The graphic revision specifications were then forwarded to Buffalo for production with a copy of the specification retained in Norfolk. These specifications served to document outstanding discrepancies and were catalogued by lesson on a VIDS Board "Revision Status File" (Figure 24) for easy reference and identification. Discrepancies, once corrected, are removed from the VIDS Board and filed. Prior to the audio-visual lessons being issued to the Pilot/NFO Training Departments, an errata sheet was prepared which fully described any pending revisions. Here, it should be noted that for those revision specifications retained for on-site production, immediate corrective action was taken whenever possible.

Summative evaluation and revision data is collected from several sources once the lessons have been accepted for student utilization. One of the primary sources for summative revision data is feedback from the "student comment section" of the Student Attitude Surveys (Fig. 25) which are completed by the students for each lesson. These surveys are then reviewed by the respective Pilot or NFO

LESSON # AND TITLE: _____ DATE: _____

GRIPE #	FRAME DESCRIPTION	FRAME #	REPORTED BY:	VERIFIED BY:*	DISCREPANCY	REMARKS/SUGGESTED REVISION	CODE
1							
2							
3							
4							
5							
6							
7							
8							
9							

*INDIVIDUAL VERIFYING DISCREPANCY WILL ALSO FILL IN THESE BLOCKS.

Figure 20. Revision Data Sheet

Type of Revision: (check boxes)

Narrative: ☐ quality ☐ technical ☐

Graphic: ☐ quality ☐ technical ☐

Instructional Material/Approach ☐

Indicate date following occurred:

1. Documented: _____
2. Mailed: _____
3. Returned: _____
4. On-Site Work Comp: _____
5. Incorporated: _____

Revision Description:

Lesson: _____ Fr. # _____

Figure 21. Audio Visual Specifications

LESSON # _____ PILOT ☐ NFO ☐

SLIDE #	DESCRIPTION OF CHANGE
GRAPHIC	
NARRATIVE	

Figure 22. Errata Sheet

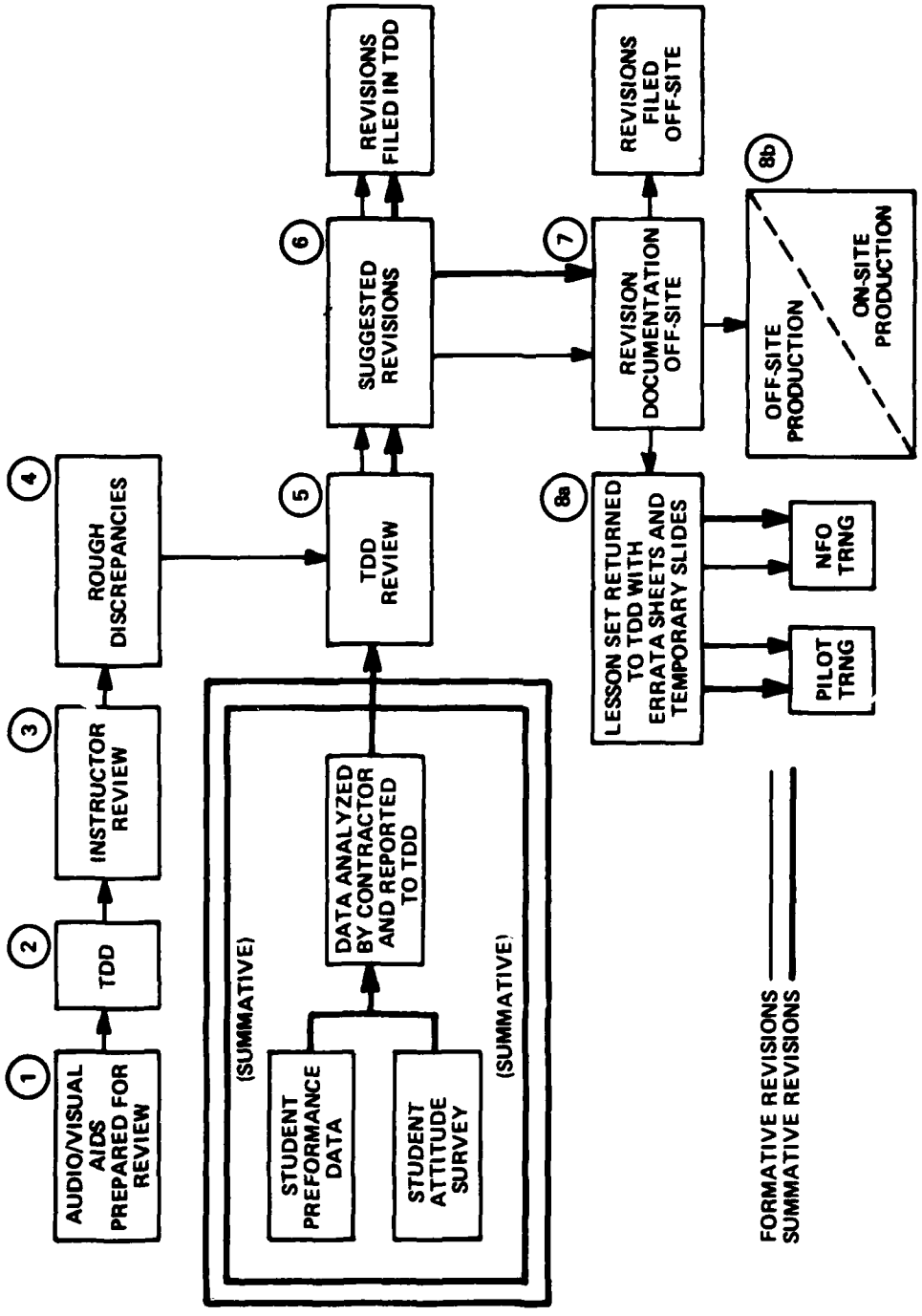


Figure 23. Formative-Summative Review

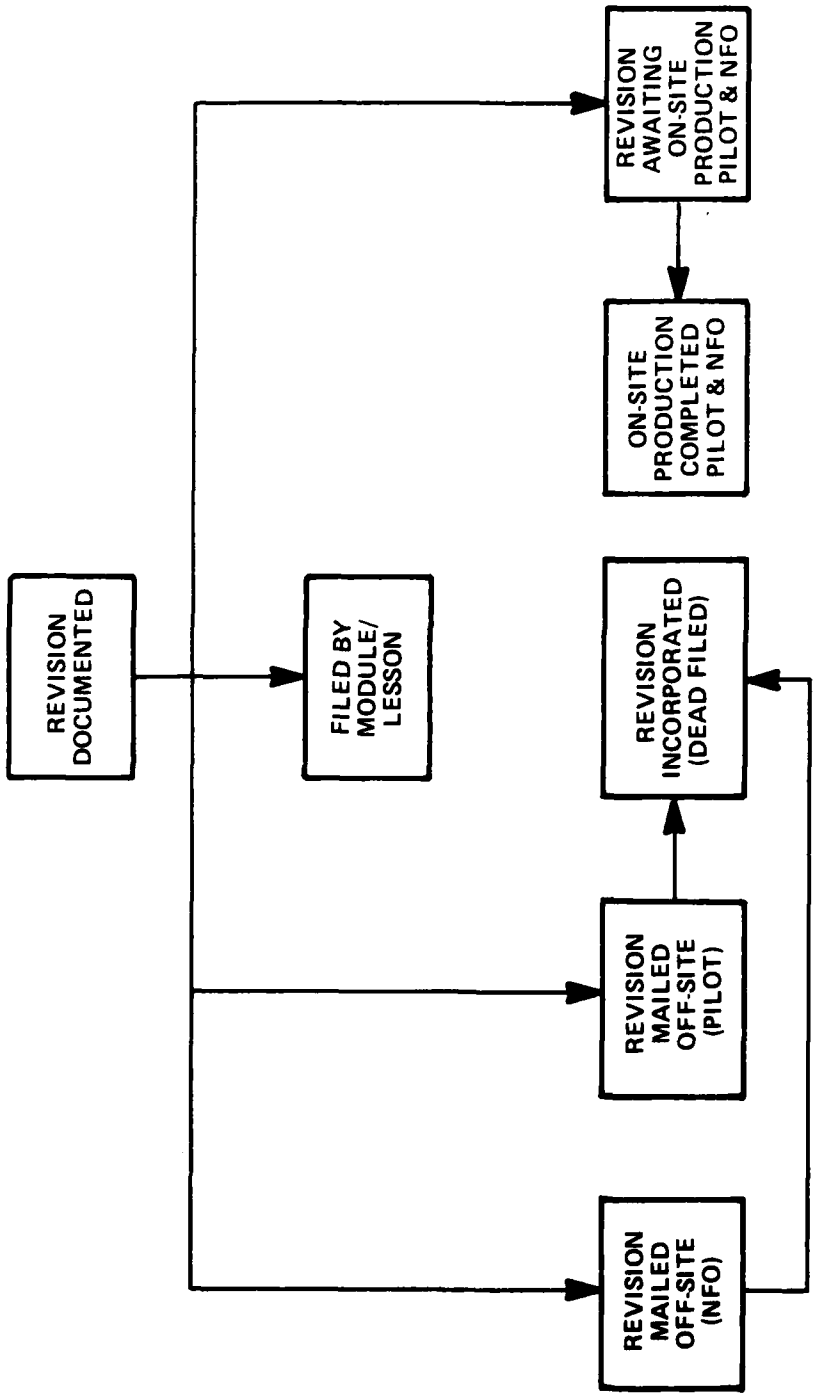


Figure 24. Revision Status File

STUDENT ATTITUDE SURVEY

LESSON # _____ TITLE _____

☐ PILOT # Errors on first test: _____

☐ NFO Time required to complete lesson: _____

DATE _____ (check out to check in)

NAME: _____ RANK/RATE _____

STUDENT CATEGORY:

☐ ONE (No previous AEW experience)

☐ TWO (Previous experience; not in model)

☐ THREE (Previous experience; in model)

OVERALL LESSON ASSESSMENT: (Circle number of choice on scale)

Poor 1 2 3 4 5 Excellent

General Comments and/or recommendations:

_____

_____

_____

_____

_____

_____

_____

_____

Figure 25. Student Attitude Survey Form

	No. of Resp.	Attitude
1. RELEVANCE: In relation to my job and career, I considered the instruction		a. extremely relevant
		b. relevant
		c. irrelevant
		d. extremely irrelevant
2. ENJOYMENT: The instruction was		a. extremely enjoyable
		b. enjoyable
		c. unenjoyable
		d. extremely unenjoyable
3. AMOUNT: The amount of information covered in this lesson was		a. overwhelming in the time allotted
		b. kept me busy
		c. easily completed in time allotted
		d. completed almost immediately
4. INTEREST: The material covered is		a. extremely interesting
		b. interesting
		c. boring
		d. extremely boring
5. CHALLENGE: The instruction in this lesson was		a. too demanding
		b. challenging
		c. not really challenging
		d. too simple
6. PREFERENCE: If given a choice for future instruction I would		a. like to take more instruction in this form
		b. not like to take any instruction in this form (if b chosen fill in c)
		c. Suggest _____ _____ form for this instruction
7. QUESTIONS: The instruction allowed for		a. opportunities to get unclear points clarified
		b. not enough opportunities to get unclear points clarified

Figure 25. (Continued)

8. ORGANIZATION: The concepts in the instruction of the material in this lesson were		a. extremely organized
		b. organized
		c. unorganized
		d. completely unorganized
9. TESTS: I found test		a. covered only the instructional materials
		b. covered material not included in the instruction
10. FEEDBACK: Opportunities for feedback were		a. completely adequate
		b. adequate
		c. inadequate
		d. completely inadequate
11. MATERIALS: Audio/Visual aids, Classroom handouts were		a. extremely easy to understand
		b. understandable
		c. difficult to understand
		d. completely confusing
		e. if c and/or d, please specify _____ _____ _____

Figure 25. (Continued)

Training personnel and then returned to TDD where they are again reviewed and evaluated. Potential problem areas and/or discrepancies are then verified through additional lesson review by TDD personnel. Discrepancies that are verified are again documented on revision data sheets and given to the contractor's on-site personnel for documentation and processing. Other sources of evaluation data include reviews of student performance records by both TDD and contractor personnel to further assist in the evaluation of internal and external program validity. This is partially accomplished through a review of student record sheets to determine both time and number of attempts required to reach criteria for the cognitive and practice lessons. External validity is further evaluated once a sufficient number of ISD-Trained students have been placed in fleet squadrons to permit the completion of a valid survey in the form of Fleet Feedback questionnaires.

SECTION IV

RESULTS AND CONCLUSIONS

SUMMATIVE EVALUATION

Data collection for the summative evaluation began with implementation and will continue on a long-term quality control basis. Internal quality control is monitored by records of student performance as described in the section entitled "curriculum," by "Student Attitude Surveys" completed for each lesson, and by the end-of-course "RVAW Critique." External validation is determined by response to the "Fleet Feedback" questionnaire.

Table 4 describes the magnitude of the total ISD effort with a breakdown of the number of Tasks, Task Elements, Behavioral Objectives, and Lessons by Media. Additionally, the number of test items and performance measures are indicated.

Tables 5 and 6 describe the pilot and NFO/FT syllabi before and after implementation of the ISD-based syllabi. These tables are presented for comparative purposes in evaluating the ISD-based training system.

Tables 7 and 8 summarize the academic performance of the ISD graduates on the lesson tests and NATOPS exams respectively. The academic norms for learning time are criterion referenced and inclusive of testing and remediation. The mean error rates are for first attempt on end-of-lesson tests. NATOPS exam scores indicate a high level of mastery in the relevant areas.

Figures 26 and 27 illustrate the results of the "RVAW Critiques" which are completed by graduates of the ISD-based training program prior to check-out. With the exception of a few squadron-related functions which are beyond the purview of ISD, the mean ratings indicate a significantly favorable assessment.

Figures 28 and 29 illustrate the graduates' appraisal of the ISD-based E-2 Training from the perspective of performance in the fleet. Each graduate is asked to complete a "Fleet Feedback" survey after completing a minimum of six months of operational duty. Commanding Officers are also asked to rate each of the ISD graduates. The results indicate a highly positive trend, especially in the Commanding Officer's assessment.

Finally, Figure 30 summarizes student attitude responses to the individual lessons. The composite data indicates "favorable" or "very favorable" acceptance in each of the eleven areas of the "Student Attitude Survey."

PROJECTED SAVINGS

The average course length for the ISD-based pilot syllabus is scheduled to be approximately 16 calendar weeks. This represents a reduction of four weeks from the previous syllabus. The NFO syllabus has been reduced from 33 weeks to approximately 26 weeks. These reductions result from efficiencies in scheduling as well as from actual decreases in syllabus hours. Of perhaps even greater importance to cost-effectiveness, the basic pilot syllabus (with the OFT) prescribes a substantial (20%) reduction in flight time through the ISD approach to training.

TABLE 4. ISD COMPONENT DATA FOR E-2 PILOT AND NFO/FT (MAY 1978)

ITEM	PILOT	NFO/FT
TASKS	84	430
TASK ELEMENTS	1105	1528
BEHAVIORAL OBJECTIVES	159	465
LESSONS BY MEDIA:		
TAPE/SLIDE	57	63
CLASSROOM	7	14
TACTICS TRAINER	1	32
OPERATIONAL FLIGHT TRAINER	12	–
COCKPIT PROCEDURES TRAINER	10	–
AIRCRAFT (GROUND)	–	3
AIRCRAFT (FLIGHTS)	14	9
APPROXIMATELY 2400 TEST QUESTIONS AND 1800 PERFORMANCE MEASURES (PRACTICE & SORTIE SCENARIO)		

TABLE 5. PILOT SYLLABUS HOURS BEFORE AND AFTER IMPLEMENTATION OF THE ISD-BASED SYLLABUS*

	BEFORE ISD	AFTER ISD
ACADEMIC TRAINING	128.0	79.5
COCKPIT PROCEDURES TRAINER	13.0	28.0**
OPERATIONAL FLIGHT TRAINER	-	37.0
TACTICS TRAINER (15F8)	-	2.5
FLIGHT TRAINING (E-2)	45.0	36.0
TRAINING SYLLABUS TOTAL	186.0	183.0

*Figures do not include the Field Carrier Landing Practice (FCLP) and Carrier Qualification (CQ) flight hours, which can only be prescribed on an individual basis.

**Figures include CPT and CPT/CRL hours.

TABLE 6. NFO/FT SYLLABUS HOURS BEFORE AND AFTER IMPLEMENTATION OF THE ISD-BASED SYLLABUS*

	BEFORE ISD	AFTER ISD
ACADEMIC TRAINING	229.0	138.0/139.0
TACTICS TRAINER (15F8)	113.5	66.0
PREFLIGHT TRAINING (E-2 GROUND-BASED)	7.0	6.0
FLIGHT TRAINING (E-2 AIRBORNE)	23.0	23.0
TRAINING SYLLABUS TOTAL	372.5	233.0/234.0

*Figures do not include AIC Training.

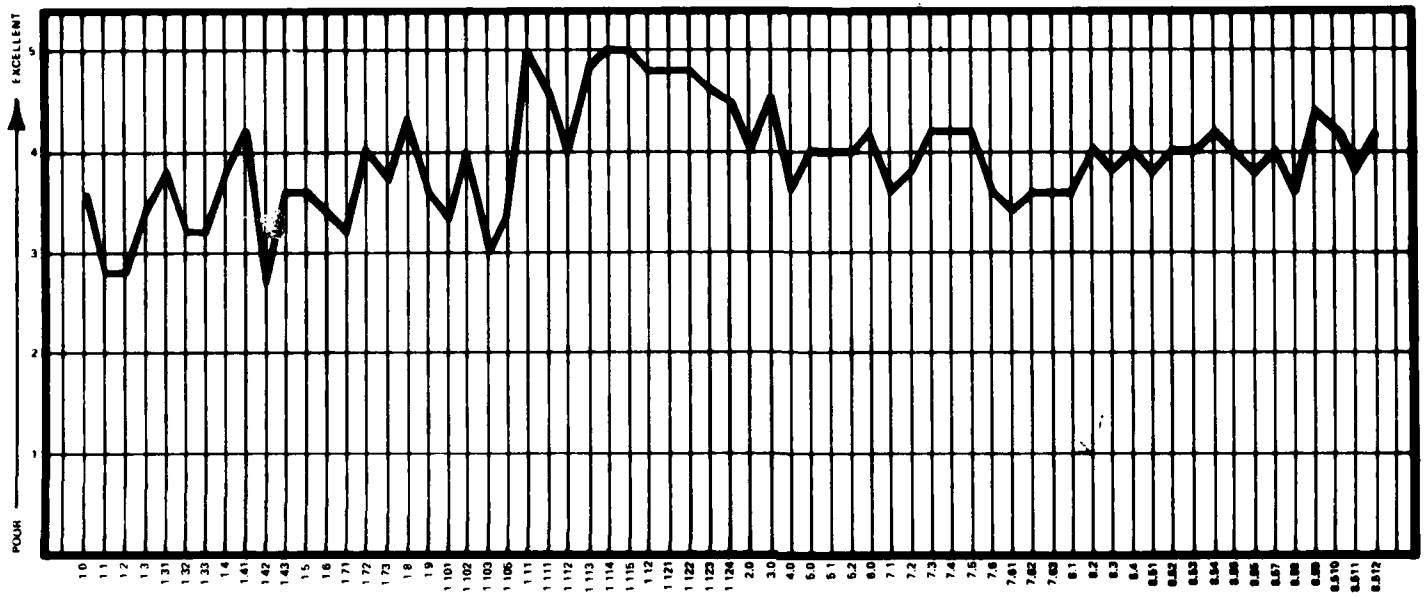
TABLE 7. ACADEMIC NORMS: E-2 ISD GRADUATES

CURRICULUM	LEARNING TIME (HOURS)	PERCENT CORRECT (FIRST ATTEMPT)
PILOT	125 - 130	80 - 84%
NFO/FT	100 - 105	80 - 84%

TABLE 8. NATOPS EXAM SCORES:* E-2 ISD GRADUATES

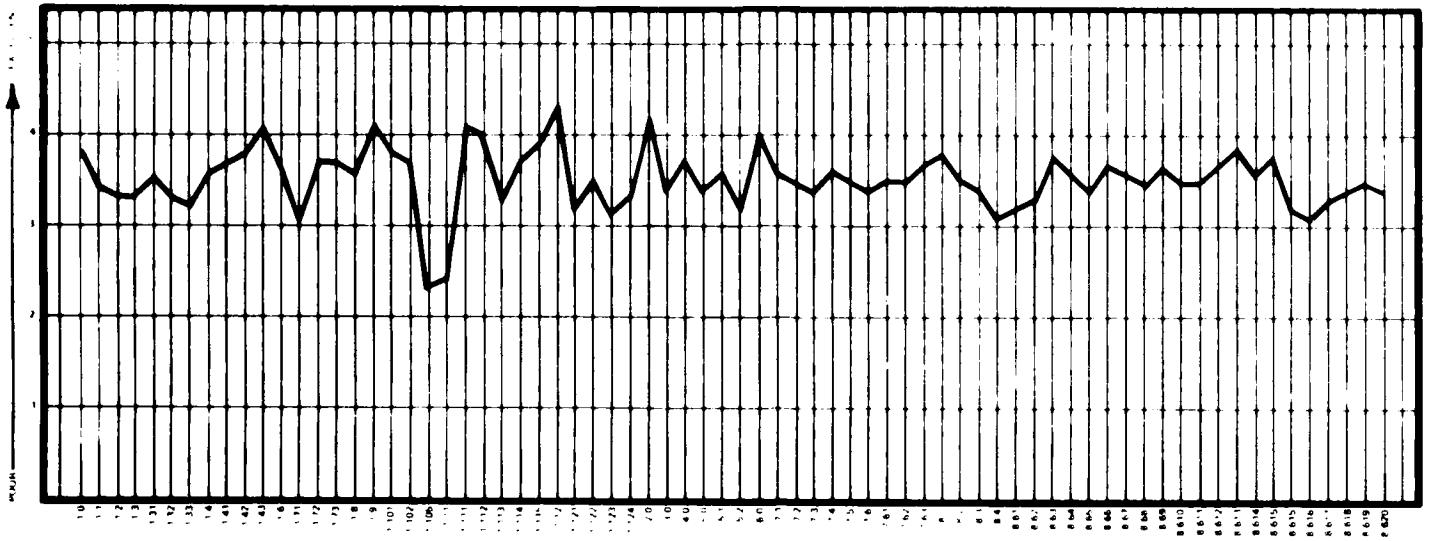
		OPEN BOOK	CLOSED BOOK	ORAL	EVALUATION FLIGHT
PILOT	$\bar{X}$ =	3.89	3.77	——	3.71
NFO/FT	$\bar{X}$ =	3.94	3.62	3.67	3.74

* 4.0 SCALE



1.0 ADMINISTRATION (GENERAL)
1.1 CHECK-IN PROCEDURES
1.2 LOCAL BRIEFING
1.3 SCHEDULING (GENERAL)
1.31 CLASSROOM SCHEDULING
1.32 TRAINER/SIMULATOR SCHEDULING
1.33 FLIGHT SCHEDULING
1.4 CLASS ORGANIZATION (GENERAL)
1.41 CLASS LEADER
1.42 STAFF ADVISOR
1.43 HOMOGENEITY OF CLASSES
1.5 WATCH STANDING
1.6 SQUADRON COMMUNICATIONS
1.71 SQUADRON COORDINATION MEDICAL
1.72 SQUADRON COORDINATION DISPERSING
1.73 SQUADRON COORDINATION OTHER SCHOOLS
1.8 ACADEMIC BOARD PROCEDURES
1.9 RECORD KEEPING
1.101 AUDIO VISUAL DEVICES
1.102 TACTICS TRAINER
1.103 COCKPIT PROCEDURES TRAINER
1.105 AIRCRAFT
1.11 INSTRUCTOR QUALITY (GENERAL)
1.111 CLASSROOM INSTRUCTOR
1.112 LEARNING CENTER SUPERVISOR
1.113 TRAINER/SIMULATOR INSTRUCTOR
1.114 FLIGHT INSTRUCTOR
1.115 NATOPS EVALUATOR
1.12 INSTRUCTOR STANDARDIZATION
1.121 CLASSROOM INSTRUCTOR
1.122 TRAINER/SIMULATOR INSTRUCTOR
1.123 FLIGHT INSTRUCTOR
1.124 NATOPS EVALUATOR
2.0 TAPE/SLIDE LESSONS
3.0 CLASSROOM LESSONS
4.0 OUTSIDE READINGS
5.0 TRAINER/SIMULATOR LESSONS
5.1 PRACTICE
5.2 SORTIES/SCENARIOS
6.0 AIRCRAFT LESSONS
7.1 PACING WITHIN LESSONS
7.2 FREQUENCY OF TESTING
7.3 KNOWLEDGE OF TEST RESULTS
7.4 SEQUENCE OF INSTRUCTION
7.5 TEST ANSWER SHEETS
7.6 TEST PROCEDURES (GENERAL)
7.61 CARREL/CLASSROOM
7.62 TRAINER/SIMULATOR
7.63 AIRCRAFT
8.1 ORGANIZATION OF PRESENTATIONS
8.2 DEPTH OF PRESENTATIONS
8.3 AREAS OF EMPHASIS IN PRESENTATIONS
8.4 MOTIVATIONAL VALUE OF PRESENTATIONS
8.51 MISSION PLANNING
8.52 BRIEFING
8.53 PREFLIGHT
8.54 PRE-TAKEOFF PROCEDURES
8.55 TAKEOFF/DEPARTURE
8.56 BASIC AIRWORK
8.57 CREW LEADING ABILITY
8.58 COMMUNICATIONS
8.59 EMERGENCY PROCEDURES
8.510 LANDINGS
8.511 POST LANDING
8.512 DEBRIEFING

Figure 26. Pilot RVAW Critique: ISD Graduates



1.0 ADMINISTRATION (GENERAL)
1.1 CHECK-IN PROCEDURES
1.2 LOCAL BRIEFING
1.3 SCHEDULING (GENERAL)
1.31 CLASSROOM SCHEDULING
1.32 TRAINER/SIMULATOR SCHEDULING
1.33 FLIGHT SCHEDULING
1.4 CLASS ORGANIZATION (GENERAL)
1.41 CLASS LEADER
1.42 STAFF ADVISOR
1.43 HOMOGENEITY OF CLASSES
1.5 WATCH STANDING
1.6 SQUADRON COMMUNICATIONS
1.71 SQUADRON COORDINATION MEDICAL
1.72 SQUADRON COORDINATION DISPERSING
1.73 SQUADRON COORDINATION OTHER SCHOOLS
1.8 ACADEMIC BOARD PROCEDURES
1.9 RECORD KEEPING
1.101 AUDIO-VISUAL DEVICES
1.102 TACTICS TRAINER
1.105 AIRCRAFT
1.11 INSTRUCTOR QUALITY (GENERAL)
1.111 CLASSROOM INSTRUCTOR
1.112 LEARNING CENTER SUPERVISOR
1.113 TRAINER/SIMULATOR INSTRUCTOR
1.114 FLIGHT INSTRUCTOR
1.115 NATOPS EVALUATOR
1.12 INSTRUCTOR STANDARDIZATION (GENERAL)
1.121 CLASSROOM INSTRUCTOR
1.122 TRAINER/SIMULATOR INSTRUCTOR
1.123 FLIGHT INSTRUCTOR
1.124 NATOPS EVALUATOR
2.0 TAPE/SLIDE LESSONS
3.0 CLASSROOM LESSONS
4.0 OUTSIDE READINGS
5.0 TRAINER/SIMULATOR LESSONS
5.1 PRACTICE
5.2 SORTIES/SCENARIOS
6.0 AIRCRAFT LESSONS
7.1 PACING WITHIN LESSONS
7.2 FREQUENCY OF TESTING
7.3 KNOWLEDGE OF TEST RESULTS
7.4 SEQUENCE OF INSTRUCTION
7.5 TEST ANSWER SHEETS
7.6 TEST PROCEDURES (GENERAL)
7.61 CARREL/CLASSROOM
7.62 TRAINER/SIMULATOR
7.63 AIRCRAFT
8.1 ORGANIZATION OF PRESENTATIONS
8.2 DEPTH OF PRESENTATIONS
8.3 AREAS OF EMPHASIS IN PRESENTATIONS
8.4 MOTIVATIONAL VALUE OF PRESENTATIONS
8.61 BRIEF PROCEDURES
8.62 PRE FLIGHT
8.63 TURN ON
8.64 SYSTEMS SYSTEM EVALUATION
8.65 AAW PROCEDURES A C CONTROL
8.66 AAW PROCEDURES (AEW PROCEDURES)
8.67 LINK 4 PROCEDURES
8.68 LINK 11 PROCEDURES
8.69 COMPUTER INDICATOR GROUP
8.610 MISC. EQUIPMENT PROCEDURES
8.611 RADAR
8.612 RDP
8.613 IDP
8.614 C P
8.615 PDS
8.616 LINK 4 TROUBLESHOOTING
8.617 LINK 11 TROUBLESHOOTING
8.618 IFPM PROCEDURES
8.619 EMERGENCY PROCEDURES
8.620 POST FLIGHT

Figure 27. NFO/FT RVAW Critique: ISD Graduates

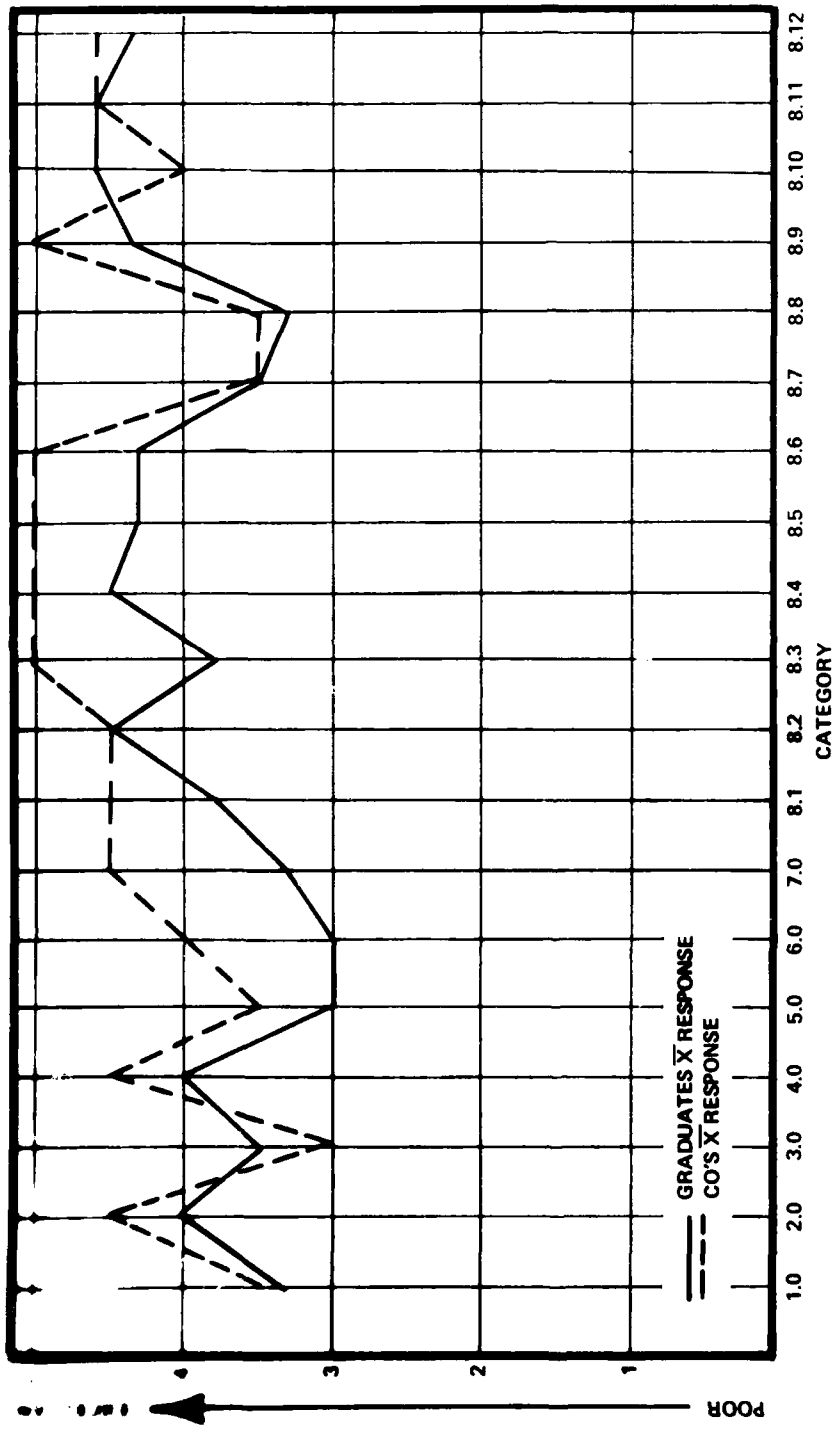
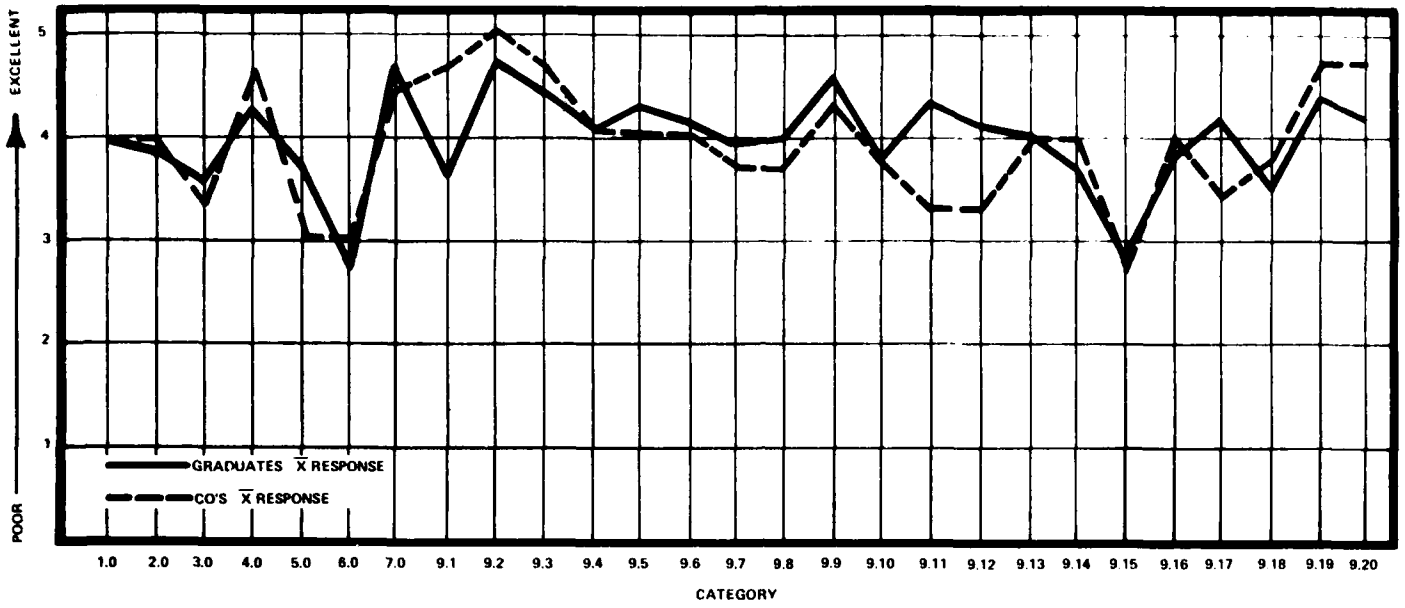


Figure 28. Pilot Fleet Feedback: ISD Graduates



1.0	MISSION PERFORMANCE (GENERAL)
2.0	AVIATION PSYCHOMOTOR SKILLS
3.0	TACTICS
4.0	"HEADWORK"
5.0	CREW COORDINATION
6.0	COLLATERAL DUTIES
7.0	NATOPS EXAMS
9.0	NFO/FT EVALUATION AREAS
9.1	BRIEF PROCEDURES
9.2	PREFLIGHT
9.3	TURN-ON
9.4	SYSTEM EVALUATION
9.5	AAW PROCEDURES A/C CONTROL
9.6	AAW PROCEDURES (AEW PROCEDURE)
9.7	LINK 4 PROCEDURES
9.8	LINK 11 PROCEDURES
9.9	COMPUTER INDICATOR GROUP
9.10	MISC. EQUIPMENT PROCEDURES
9.11	RADAR
9.12	RDP
9.13	IDP
9.14	C-P
9.15	PDS
9.16	LINK 4 TROUBLESHOOTING
9.17	LINK 11 TROUBLESHOOTING
9.18	IFPM PROCEDURES
9.19	EMERGENCY PROCEDURES
9.20	POST-FLIGHT

Figure 29. NFO/FT Fleet Feedback: ISD Graduates

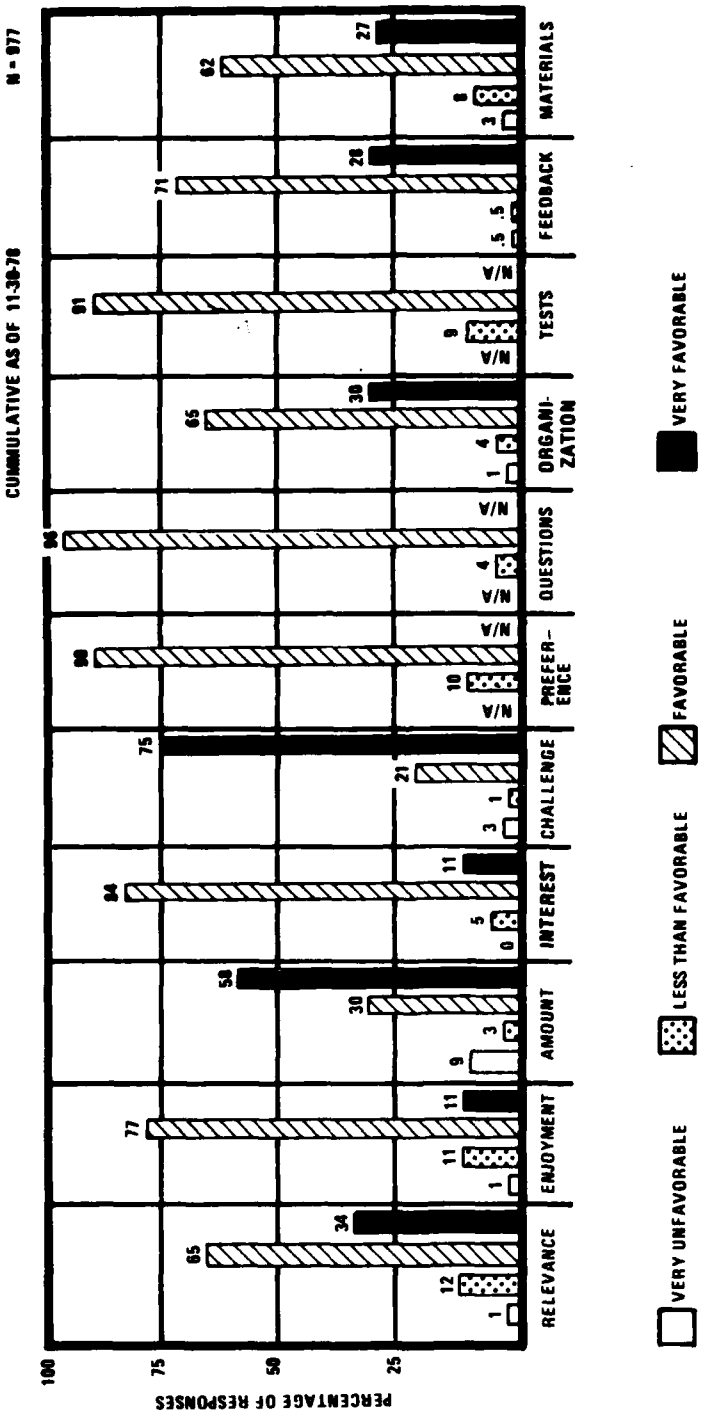


Figure 30. Combined Pilot and NFO/FT Responses to Student Attitude Survey

CONCLUSIONS

TRAINING DEVELOPMENT METHODS. The contractor's methodology appears to have successfully integrated the systematic procedures of ISD with the professional judgments of instructional psychologists and subject matter experts. The framework established by the contractor's analysis and design studies in Phase I has directed the Phase II development, but in an iterative fashion. In many cases, subject matter considerations and squadron resources and constraints have suggested modifications to the originally-proposed ISD-based syllabus and lesson specifications. These changes have been incorporated whenever justified by appropriate revisions to the analytical data bases (i.e. Task Analysis, Behavioral Objectives, Method-Media Selection). The resulting curriculum is therefore completely ISD-based but also enhanced by a responsive system of Navy SME input.

TRAINING DEVELOPMENT IMPLEMENTATION. The utilization of Navy SMEs for the authoring of training materials under the direction of contractor IPs has been successfully integrated into the E-2 ISD program. The success of this approach is closely tied to the teaming of Navy and contractor technical management with mutual understanding of areas of expertise and responsibility. Under this direction, highly-skilled SMEs can be very effective. Naval officers in the E-2 community have proven to be readily adaptable to the ISD tasks through SME author training provided by documented guidelines and on-the-job experience. Additionally, attention to the affective domain in their transition to the ISD approach appears to have been a crucial factor in their effectiveness. Of equal importance, the input of operational squadron personnel has been a prime consideration.

TRAINING DEVELOPMENT RESOURCES. The availability of Navy SMEs for work on the ISD tasks has been a critical problem. Despite a concerted squadron commitment to the effort, production was delayed due to problems in this area. Corrective actions were taken early enough, however, to meet the needs of the effort. Accordingly, additional man-power resources were incorporated through temporary duty assignments of personnel assigned by the Wing, part-time utilization of squadron personnel outside the TDD/ISD Departments, and contractor SME support. It appears that the use of contractor SMEs was a critical factor to the successful implementation. Therefore, it is recommended that future programs follow such an approach to fill a significant portion of the authoring task. Nevertheless, the contractor's on-site conduct of the effort and the participation of Navy SMEs for direction, review, and as much authoring as can be feasibly accommodated, appears to be warranted.

RECOMMENDED ADJUSTMENTS TO SPECIFICATIONS. While the E-2 ISD effort was not directed by the MIL-T-29053 specification, the contractor has incorporated its input whenever feasible. Three areas within that specification and its corresponding DIDs appear to be in need of revision. The first suggested revision involves the need for detailed guidelines on the format and style for instructional materials production, particularly in the audio-visual domain. The second suggested revision involves the DID entitled "Quality Control Report" (UDI-H-25729). It is recommended that the reporting format for revision documentation be modified to reflect depth as well as quantity. The third suggested revision involves the DID entitled "Training Program Work Report" (UDI-H-25731). It is recommended that redundancies in the ISD and Implementation sections be eliminated, and that a formal section on "Evaluation Data" be incorporated.

OBSERVATIONS. The E-2 ISD program appears to have made a significant contribution to the ISD methodology in the area of developing documentation for "hands-on" lessons. Instructor and Student Guides have been developed in a manner which relates directly to the Behavioral Objectives. Corresponding evaluation scales which provide the instructor with the opportunity to teach performance skills as well as assess student performance have also been successfully incorporated. It appears that these provisions have greatly enhanced the syllabi.

A second observation applies to audio-visual materials. It appears that the visual fidelity employed in the E-2 tape/slide presentations has greatly facilitated the learning process by forming the cornerstone of a building block approach to psychomotor skills development. The contractor has developed many graphic techniques to make this approach cost-effective.

SECTION V

RESOURCE UTILIZATION

Figures 31 and 32 present task expenditure data for the E-2 ISD program. For each task, contractor data includes category of assigned personnel and manhours expended. Data provided on Navy support include manhours expended for supervisors, NFOs and pilots.

PROBLEM AREAS

Several problems developed which had a significant impact on resource utilization and expended contractor funds.

SME time proved to be a serious problem for the Navy. This was the result of a contractual requirement for more SME personnel than were available, resulting in slippage in the storyboard/lesson guide production schedules. A solution to the problem was the hiring of additonal SMEs by the contractor and temporary duty assignments for Naval personnel from outside the Squadrons and the Wing. These SMEs supported the storyboard/lesson guide production as well as authored classroom materials, student handouts, and tests.

A long-term delay in the delivery of the E-2C OFT necessitated the development of an interim pilot syllabus relying more heavily on aircraft and Cockpit Procedures Trainer usage. This interim flight syllabus was not part of the original program.

The absence of definitive guidelines on the artistic approach for tape/slide lessons resulted in many iterations of artwork before a technique was developed that was acceptable to the Navy and the contractor.

The hardware change from the APS-120 to the APS-125 required development of two separate tracks in the NFO syllabus, and the addition of several lessons which were not part of the orginal program.

A final problem, and one that will impact on the program in the future, was the rapid frequency of software changes in the E-2C aircraft itself and in the 15F8 Tactics Trainer.

REQUIRED EQUIPMENT AND FACILITIES

Government-furnished office space and equipment was provided for the contractor at NAS Norfolk. Personnel assigned to this office included three instructional psychologists, one training analyst, a technical writer, and secretarial and typing support.

TASKS	CONTRACTOR PERSONNEL ASSIGNED CATEGORY	CONTRACTOR MANHOURS EXPENDED	NAVY ISD MANHOURS EXPENDED SUPERVISOR	NFO	PILOT
PROGRAM PLANNING	* INSTRUCTIONAL PSYCHOLOGISTS, TRAINING ANALYSTS, AND ADMINISTRATIVE SUPPORT	2326	1320	323	428
COURSE REVIEW		244	195	342	92
LESSON SPEC REVIEW		126	60	293	135
FLESHING LESSON SPEC		190	67	464	323
STORYBOARDING		2200	243	1910	2287
TEST DEVELOPMENT		214	90	372	222
MATERIAL TRYOUT		990	86	120	76
FORMATIVE REVISION		16	106	466	62
INSTRUCTOR TRAINING		540			
GRAPHICS SUPPORT:					
PHOTOGRAPHER	PHOTOGRAPHER	2020			
PHOTOMECHANICS	PHOTOMECHANICS	815			
ILLUSTRATOR	ILLUSTRATOR	9173			
SPECIALTY TYPIST	TYPIST	123			
REPORT REPRO	REPORT REPRO	244			
	TOTAL:	19221	2167	4290	3625

* SECRETARIAL, NARRATION AND MISCELLANEOUS PURCHASED SERVICES NOT INCLUDED ABOVE.

Figure 31. Resource Utilization Log (October 31, 1976 - May 28, 1978)

TASKS	CONTRACTOR PERSONNEL ASSIGNED*								NAVY PERSONNEL ASSIGNED					
	IP		IT		GRAPHICS		SEC'Y		SUPER-VISOR		NFO		PILOT	
	#	HRS	#	HRS	#	HRS	#	HRS	#	HRS	#	HRS	#	HRS
PROGRAM ADMINISTRATION	2	500	1	88	–	–	1	460	4	1990	–	–	–	–
IMPLEMENTATION & EVALUATION	2	607	1	200	–	–	1	230	–	–	–	–	–	–
REVISION CONSULTATION	2	584	4	1361	7	4680	3	1353	–	–	8	2265	2	560
INSTRUCTOR-UNDER-TRAINING-SYLLABUS	2	326	1	60	4	600	1	300	–	–	3	110	1	20
TOTAL HOURS:		2017		1709		5280		2343		1990		2375		580

*NARRATION AND MISCELLANEOUS PURCHASED SERVICES NOT INCLUDED ABOVE

Figure 32. Resource Utilization Log (May 29, 1978 - July 5, 1979)

The remainder of the requirements for equipment and facilities support was necessary for audio-visual production. Contractor-provided equipment included: furniture and art supplies for seven illustrators; 35mm slide camera; slide duplicating and photography processing equipment and chemicals; and report reproduction equipment.

Task Duration for Phase II E-2 ISD Program

Instructional Materials Development	21 months
Aviation Training Support System (ATSS)	12 months
Evaluation Planning	2 months
Implementation Planning	2 months
Instructor Training Course	5 months
Implementation and Evaluation	6 months
Revision Consultation	7 months

Task Duration for Follow-on Revision*

Extension of Summative Evaluation	18 months
Revision Specifications	18 months
Graphics/Narration Revision	18 months
IUT Syllabus	13 months

*Includes overlap with Phase II and "C-3" NFO/FT Revision

APPENDIX A

AUDIO-VISUAL PRODUCTION

The audio-visual production techniques described in this Appendix were developed as a sub-task within Phase II of the E-2 ISD effort on Navy Contract N61339-77-C-0003. The major task of this program, Instructional Materials Development, was comprised of: lesson specification reviews, detailing of lesson specifications, authoring and test development, production, and materials tryout and formative revision. Although the production sub-task also included typing, printing, and duplicating support for "hard copy" training materials, only the complex audio-visual processes will be addressed here.

Detailing of the lesson specifications developed by the contractor on Phase I of the E-2 ISD program was primarily the function of Navy and contractor subject matter experts (SMEs) in Norfolk. These detailed lesson specifications were used as guidelines for storyboarding the tape-slide lessons. For each teaching point, the detailed storyboard process provided a frame-by-frame description of the visual, corresponding narrative, and related test items. The result was several thousand pages of documentation for input to the audio-visual production process.

PRODUCTION QUALITY CONTROL

After extensive technical review of the storyboards by the SMEs and TDD in Norfolk, each lesson was reviewed by contractor media specialists in Buffalo. This review process standardized the visual material presentation and amplified the productions details for the illustrators.

Because approximately 50,000 slides were generated during the production effort of Phase II, a "tracking" procedure was developed to account for each frame of instruction. As each lesson was reviewed by media specialists, a log sheet was completed for every frame indicating the type of visual support required (e.g., contractor-generated art, photograph or direct pick-up from existing visual material).

Daily interaction between the media specialists and illustrators provided answers to artistic approach questions as they occurred, and technical direction was received from Norfolk. Review of finished artwork also occurred daily, allowing for immediate feedback to the illustrator on artistic approach and technical material. After review and correction, each piece of finished art was labeled with lesson and frame numbers and then photographed.

Two original slides were made for each piece of contractor-generated art. After developing and mounting, one of these slides was retained for the master file. The second original slide became the master from which the necessary duplicates were made. Completed slides were labeled, collated, and filed in Carousel slide trays.

VISUAL PRODUCTION

In determining the artistic approach for visual production, the contractor was directed to utilize as many of the existing slides as possible to effect cost savings. Incorporating revised technical information and new material required the development of processes that would produce artwork that was compatible with the quality and techniques of the existing material.

The bulk of the original art was produced in two ways. For the first technique, NFO panels and gauges were rendered using an airbrush technique which resulted in a realistic representation of the material. In the second technique, a multi-step "Disney" approach was used to create realistic pilot panels and gauges. These two techniques are discussed in greater detail in the following paragraphs.

AIRBRUSH RENDERINGS

The first step in the airbrush rendering process is tracing the panel and gauge faces from existing engineering drawings. The tracings are "painted" with an airbrush, filling in a solid background first, then adding shadows where switches and dials are to appear. Color photographs of all panels and gauges provide the necessary detail for accurate color matching of console faces and the various indicator lights.

Completed airbrushed panels and gauges are photographed to provide bases on which to indicate various switch positions and dial readings. Using a rub-on transfer technique, switches and dials are applied to the photographed panel, and gauge needles are positioned where necessary. Great quantities of original art can be rapidly generated by simply changing a dial or switch position in this way.

An example of a panel completed using an airbrush technique and rub-on transfers for labeling switches is shown in Figure A-1. Figure A-2 is an example of switches applied with a rub-on transfer.

"DISNEY" APPROACH

The first step in the "Disney" approach is to trace the panel and gauge faces from existing engineering drawings. At this point, only the outline is traced, and switches and dial locations are added. The panel lettering is sized by the typist.

In the second step of the process, the original material produced in the preceding step is photographed. This results in a print that allows easy application of the rub-on transfer material.

In step three, switches are applied in the correct position using rub-on transfer material. Only necessary touch-ups are made at this point.

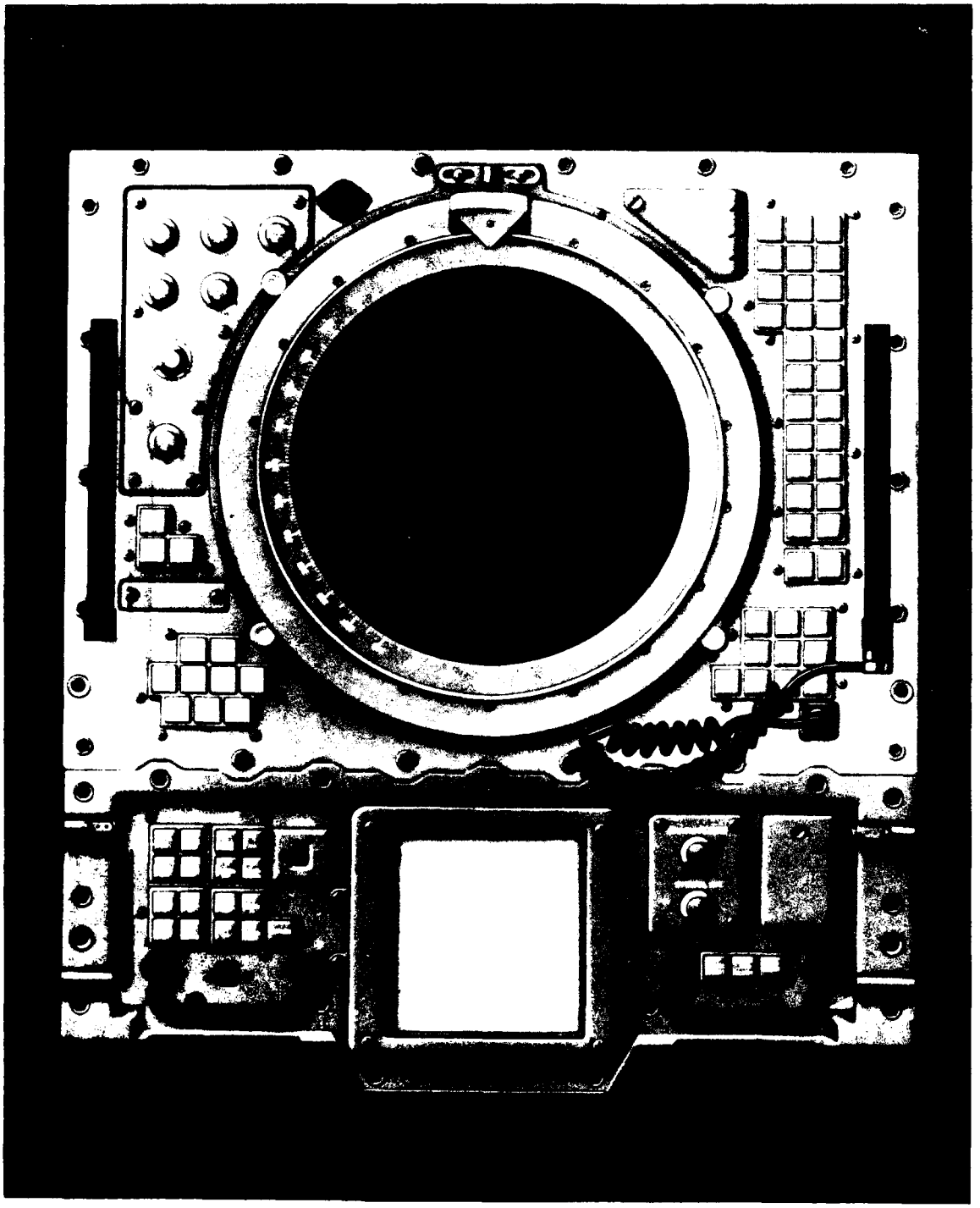


Figure A-1. EXAMPLE OF AIRBRUSHED RENDERING

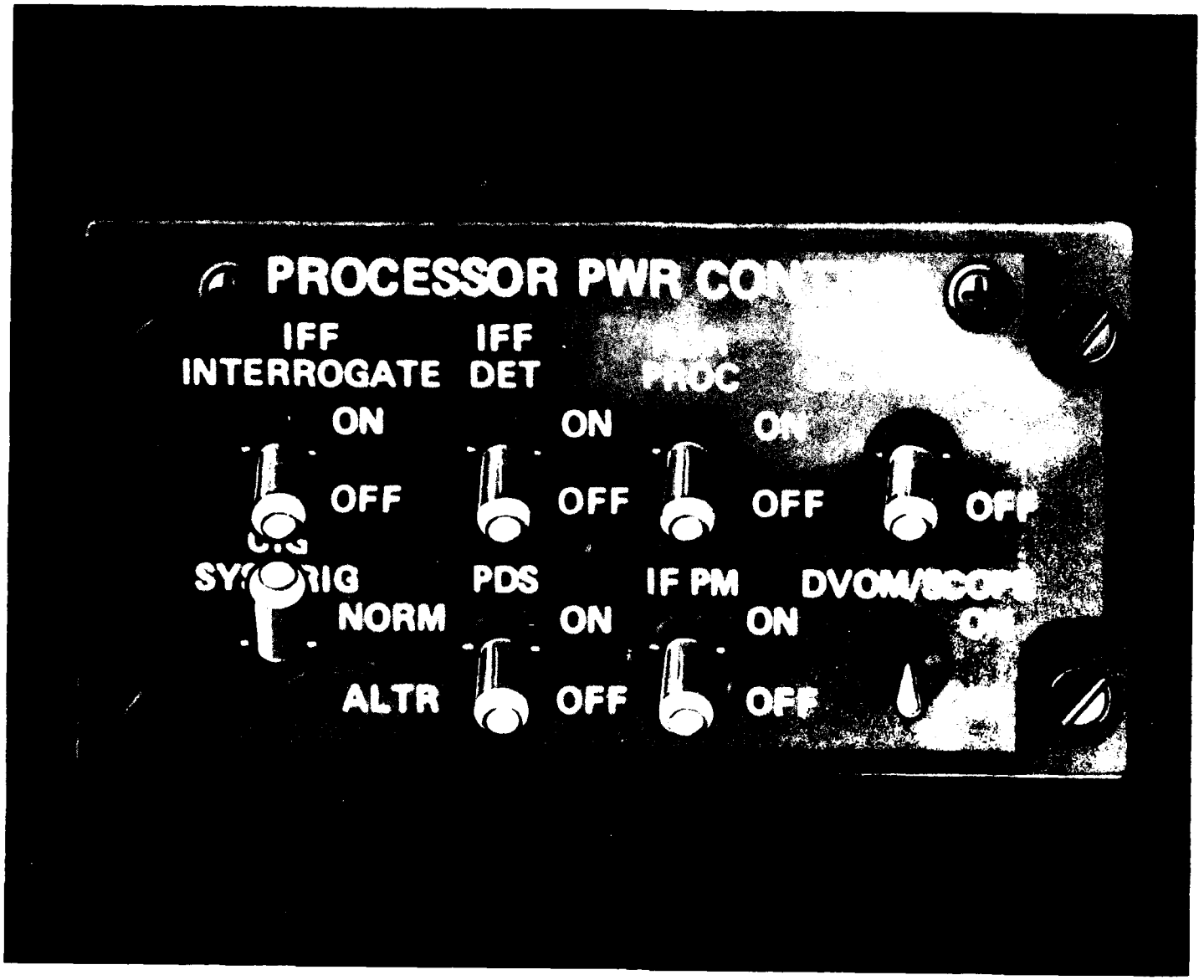


Figure A-2. EXAMPLE OF RUB-ON SWITCH TECHNIQUE

In step four, a film positive is made of the artwork, and an overlay of the lettering is added. The back of the film positive is painted, and shadows are added, resulting in a realistic representation.

In step five, all layers of material are assembled on a layout board and double-checked for technical accuracy. After the board is labeled with lesson and frame numbers, the finished art is ready for the camera.

In the final step of this process, step six, the finished art is photographed as an original slide. Examples of each step of this process can be seen in Figures A-3a - A-3f.

MODIFICATION OF EXISTING SLIDES

As mentioned earlier, training material already existed from a previous E-2 effort. Whenever possible, this material was used without modification. When teaching points called for visual support which required a minor change to artwork already in existence, a print was made from the appropriate negative. Necessary modifications were made to the print using any of the previously-described techniques, and the revised photograph was mounted on an illustration board and photographed as an original slide.

AUDIO PRODUCTION

Because audio production was handled in Norfolk, completed tape/slide lesson packages were supplied to the Navy in two ways. Slide trays for use in RVAW-120 implementation were sent directly to Norfolk from the contractor's Buffalo facility. In Norfolk, each slide tray was checked out with the appropriate audio tape before the tray was used by students. For RVAW-110 implementation, completed audio tapes were sent to Buffalo from Norfolk, where the tapes were checked out with the appropriate slide trays and then forwarded to San Diego.

COMMENTS

Significant cost savings were realized by use of the art techniques described in this Appendix. Although the airbrush rendering and "Disney" approaches have significant start-up time in their first step, the greatest savings occur once all the original panels and gauges have been inked and realistically colored. From that point on, multiple photographs of the original art can be made in the different sizes required to produce the necessary bases for each frame of instruction.

A significant saving in illustrator time was realized by use of the rub-on transfer techniques for switches, dials, and lettering. Changes in switch positions could be handled in a matter of a few minutes, without having to go through the time-consuming process of generating entire pieces of original art from "scratch."

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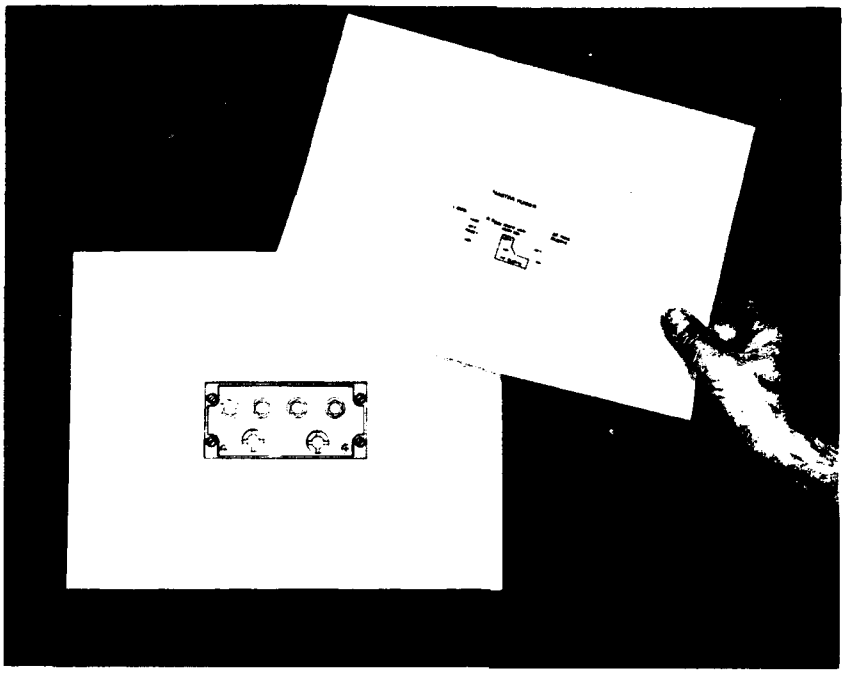


Figure A-3a. "DISNEY" APPROACH: STEP 1

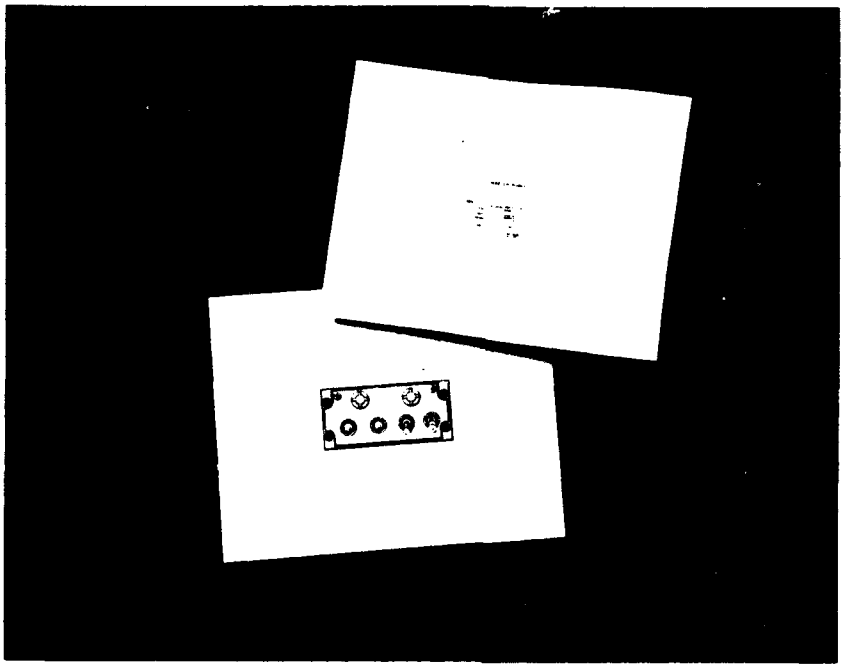


Figure A-3b. "DISNEY" APPROACH: STEP 2

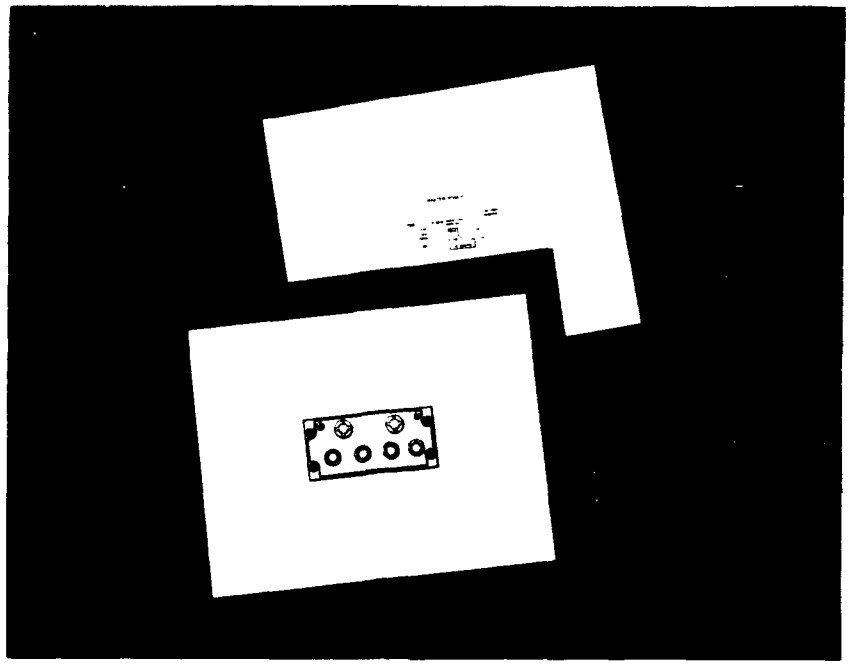


Figure A-3c. "DISNEY" APPROACH: STEP 3

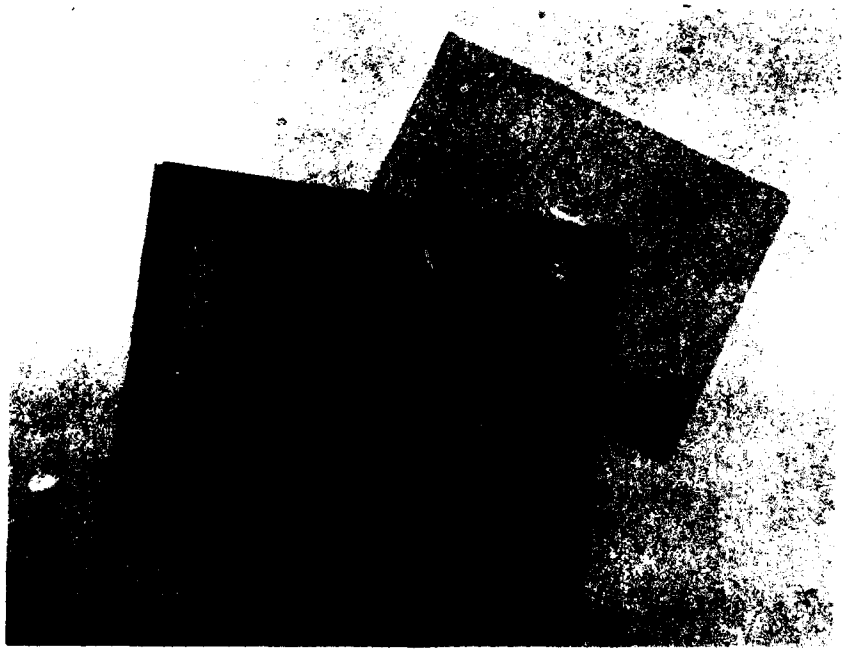


Figure A-3d. "DISNEY" APPROACH: STEP 4

Figure A-3e. "DISNEY" APPROACH: STEP 5

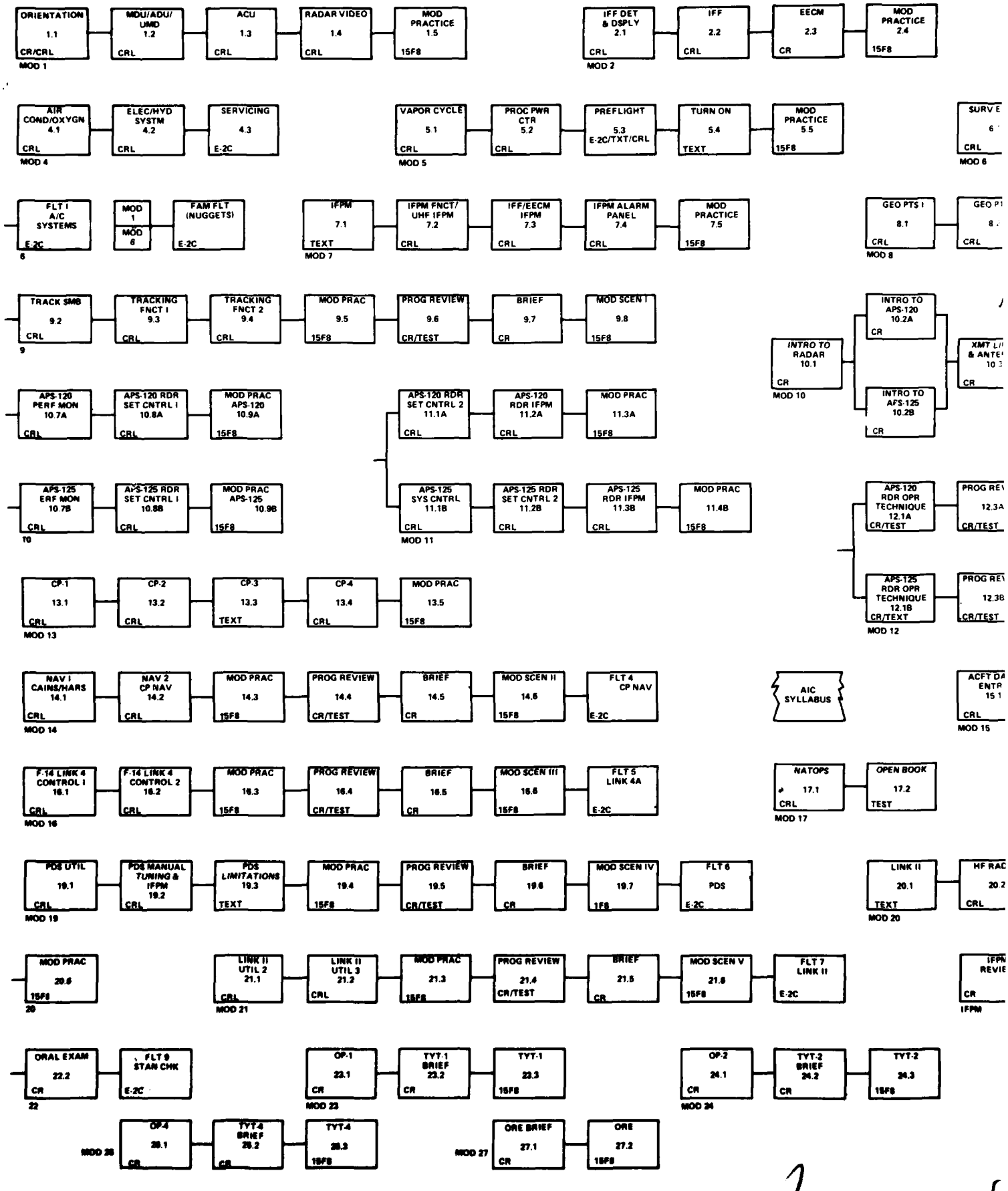
Figure A-3f. "DISNEY" APPROACH: STEP 6

APPENDIX B
NFO SYLLABUS REVISION (C3)

The recent incorporation of software changes into the E-2C NFO Training Syllabus is a result of the implementation of tape C3/A3. This new software tape represents a significant change to the various computer subprograms which make up the overall E-2C Tactical Program. Although the basic function of the subprograms is virtually unchanged, the display of data and operator interface functions have changed significantly. In addition to the 32 Categories and Functions which were deleted, approximately 6 new Categories and 19 Functions were added and 111 existing functions were either moved to other existing categories or in some other way modified. The restructuring of the Categories and Functions necessitated the generation of 24 completely new lessons directly related to the C3/A3 tape as well as the modification of 8 additionally existing lessons.

As a result of the C3/A3 software tape change, the NFO Training Syllabus has undergone major revision in the areas of subject matter and lesson sequencing. Although the number of lessons and course length remain relatively unchanged, the restructuring of the syllabus provides a more orderly presentation of subject matter in relation to the Integrated Flight Syllabus[a]. Additionally, the AIC Course has been moved from the initial portion of the syllabus so that it now takes place at a point where the student has already completed Flight #4 in the aircraft and all of the basic software lessons. Following the AIC Course, the Student then re-enters the basic syllabus and proceeds to the more complex lessons, flights, and Tactics Trainer exercises.

[a]The Integrated Flight Syllabus was an interim syllabus change which was instituted after original NFO Training Syllabus implementation.


ORIENTATION 1.1 CR/CRL
MDU/ADU/UMD 1.2 CRL
ACU 1.3 CRL
RADAR VIDEO 1.4 CRL
MOD PRACTICE 1.5 15F8
MOD 1
IFF DET & DSPLY 2.1 CRL
IFF 2.2 CRL
EECM 2.3 CR
MOD PRACTICE 2.4 15F8
MOD 2
AIR COND/OXYGN 4.1 CRL
ELEC/HYD SYSTM 4.2 CRL
SERVICING 4.3 E-2C
MOD 4
VAPOR CYCLE 5.1 CRL
PROC PWR CTR 5.2 CRL
PREFLIGHT 5.3 E-2C/TXT/CRL
TURN ON 5.4 TEXT
MOD PRACTICE 5.5 15F8
MOD 5
SURV E 6 CRL
MOD 6
FLT I A/C SYSTEMS E-2C
MOD 1 MOD 6
FAM FLT (NUGGETS) E-2C
6
IFPM 7.1 TEXT
IFPM FNCT/UHF IFPM 7.2 CRL
IFF/EECM IFPM 7.3 CRL
IFPM ALARM PANEL 7.4 CRL
MOD PRACTICE 7.5 15F8
MOD 7
GEO PTS I 8.1 CRL
GEO PT 8 CRL
MOD 8
TRACK SMB 9.2 CRL
TRACKING FNCT I 9.3 CRL
TRACKING FNCT 2 9.4 CRL
MOD PRAC 9.5 15F8
PROG REVIEW 9.6 CR/TEST
BRIEF 9.7 CR
MOD SCEN I 9.8 15F8
9
INTRO TO RADAR 10.1 CR
INTRO TO APS-120 10.2A CR
INTRO TO AFS-125 10.2B CR
XMT L/I & ANTE 10.3 CR
MOD 10
APS-120 PERF MON 10.7A CRL
APS-120 RDR SET CNTRL I 10.8A CRL
MOD PRAC APS-120 10.9A 15F8
APS-120 RDR SET CNTRL 2 11.1A CRL
APS-120 RDR IFPM 11.2A CRL
MOD PRAC 11.3A 15F8
APS-125 ERF MON 10.7B CRL
APS-125 RDR SET CNTRL I 10.8B CRL
MOD PRAC APS-125 10.9B 15F8
10
APS-125 SYS CNTRL 11.1B CRL
APS-125 RDR SET CNTRL 2 11.2B CRL
APS-125 RDR IFPM 11.3B CRL
MOD PRAC 11.4B 15F8
MOD 11
APS-120 RDR OPR TECHNIQUE 12.1A CR/TEST
PROG REV 12.3A CR/TEST
APS-125 RDR OPR TECHNIQUE 12.1B CR/TEXT
PROG REV 12.3B CR/TEST
MOD 12
CP 1 13.1 CRL
CP 2 13.2 CRL
CP 3 13.3 TEXT
CP 4 13.4 CRL
MOD PRAC 13.5 15F8
MOD 13
NAV I CAINS/HARS 14.1 CRL
NAV 2 CP NAV 14.2 CRL
MOD PRAC 14.3 15F8
PROG REVIEW 14.4 CR/TEST
BRIEF 14.5 CR
MOD SCEN II 14.6 15F8
FLT 4 CP NAV E-2C
MOD 14
AIC SYLLABUS
ACFT DA ENTR 15.1 CRL
MOD 15
F-14 LINK 4 CONTROL I 16.1 CRL
F-14 LINK 4 CONTROL 2 16.2 CRL
MOD PRAC 16.3 15F8
PROG REVIEW 16.4 CR/TEST
BRIEF 16.5 CR
MOD SCEN III 16.6 15F8
FLT 5 LINK 4A E-2C
MOD 16
NATOPS 17.1 CRL
OPEN BOOK 17.2 TEST
MOD 17
PDS UTIL 19.1 CRL
PDS MANUAL TUNING & IFPM 19.2 CRL
PDS LIMITATIONS 19.3 TEXT
MOD PRAC 19.4 15F8
PROG REVIEW 19.5 CR/TEST
BRIEF 19.6 CR
MOD SCEN IV 19.7 1F8
FLT 6 PDS E-2C
MOD 19
LINK II 20.1 TEXT
HF RAD 20.2 CRL
MOD 20
MOD PRAC 20.6 15F8
20
LINK II UTIL 2 21.1 CRL
LINK II UTIL 3 21.2 CRL
MOD PRAC 21.3 15F8
PROG REVIEW 21.4 CR/TEST
BRIEF 21.5 CR
MOD SCEN V 21.6 15F8
FLT 7 LINK II E-2C
MOD 21
IFPM REVIE CR
IFPM
ORAL EXAM 22.2 CR
FLT 9 STAN CHK E-2C
22
OP-1 23.1 CR
TYT-1 BRIEF 23.2 CR
TYT-1 23.3 15F8
MOD 23
OP-2 24.1 CR
TYT-2 BRIEF 24.2 CR
TYT-2 24.3 15F8
MOD 24
OP-4 26.1 CR
TYT-4 BRIEF 26.2 CR
TYT-4 26.3 15F8
MOD 26
ORE BRIEF 27.1 CR
ORE 27.2 15F8
MOD 27

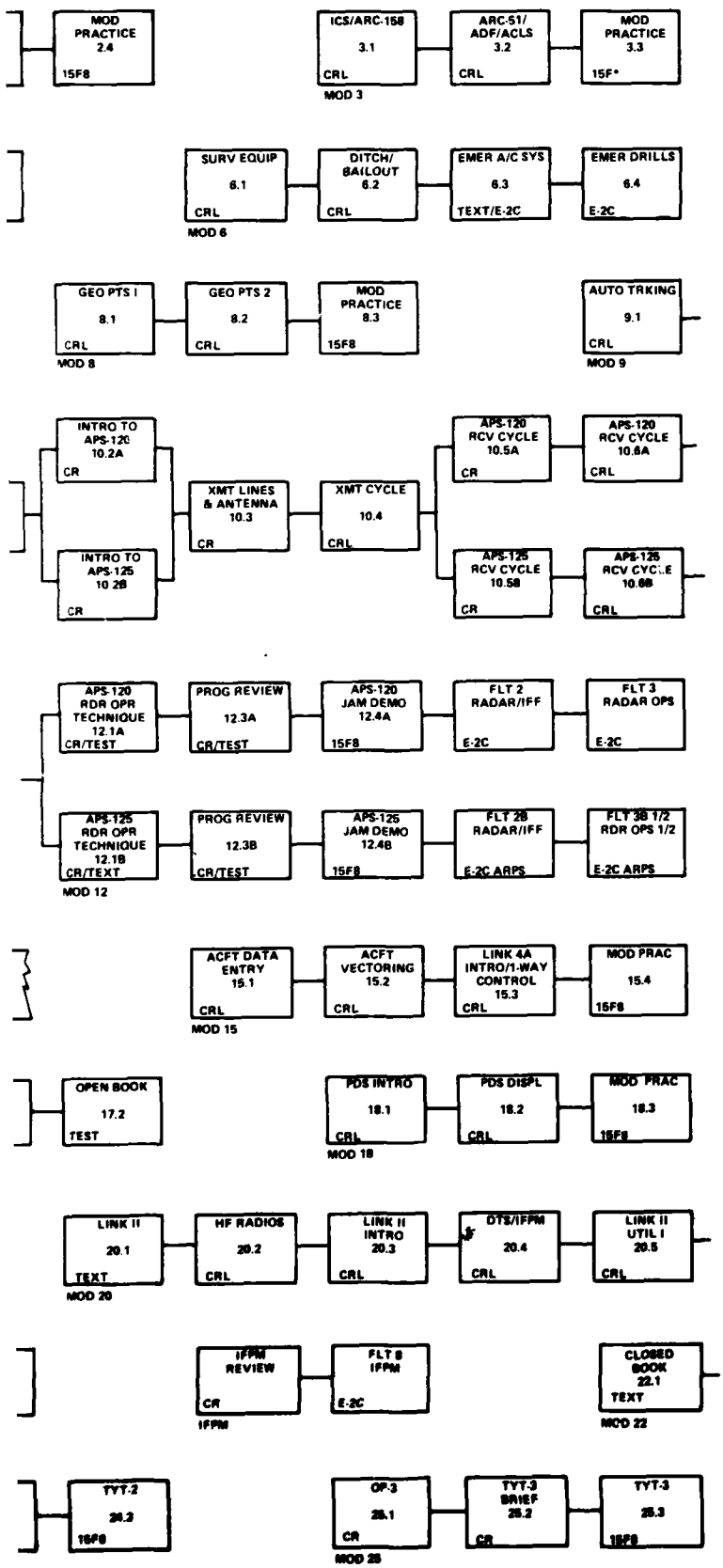


Figure B-1 NFO TRAINING SYLLABUS: C-3 MODIFICATION

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